MacArthur Bridge (Citizens' Bridge)
Burlington
Des Moines County, Iowa
Henderson County, Illinois

HAER No. IA-21

HAER,
IOWA,
29-BURL,
7-

PHOTOGRAPHS
HISTORICAL AND DESCRIPTIVE DATA

Historic American Engineering Record
Department of the Interior
National Park Service
Rocky Mountain Regional Office
P.O. Box 25287
Denver Colorado 80225

HAER
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29-BURL.
7-

Historic American Engineering Record

MacArthur Bridge

Location:	Spanning the Mississippi River on U.S. Highway 34, between Iowa and Illinois at Burlington, Iowa; SW 1/4 of Section 33, Township 10 North, Range 6 West; Des Moines County, Iowa; Henderson County, Illinois; UTM: 15.660340.4519520 - 15.661010.4519315
USGS Quadrangle:	Burlington, Iowa - Illinois [7.5 minute series, 1976]
Date of Construction:	April 1916 - March 1917
Superstructure:	Wisconsin Bridge and Iron Company, Milwaukee Wisconsin J.F. Jackson, Designing Engineer C.F. Womelsdorf, Resident Engineer
Substructure:	Green Construction Company, Green Bay Wisconsin
Present Owner:	City of Burlington
Present Use:	Two-lane highway bridge
Significance:	After decades of agitating by the citizens of Burlington, local businessman J.A. MacArthur formed the Citizens' Bridge Company in 1915 and erected this bridge, using an innovative financing plan. The structure was taken over by the City of Burlington in 1923 and has functioned as a toll bridge since. The MacArthur Bridge is historically significant as a regionally important crossing of the Mississippi River: the source of millions of dollars of revenue. It is technologically significant as the oldest cantilever truss and the oldest highway-only bridge remaining over the Mississippi.
Report Assembled by:	Clayton B. Fraser Principal, FRASERdesign Loveland Colorado 80537
	June 1988

INTRODUCTION

The story of the MacArthur Bridge is the story of commerce. Commerce, and for one dedicated Burlington businessman, civic responsibility. The citizens of Burlington had talked for decades about securing a wagon bridge over the Mississippi River into their city to bolster trade with western Illinois. All attempts had failed, however. It would not be until J.A. MacArthur devised an innovative financing plan and then implemented it in the face of almost constant criticism that the long-awaited structure would become a reality. Once built, the bridge has paid for itself many times over, both directly in the form of tolls collected by the city and indirectly from the increased traffic and commerce it has generated. Although once promised to be made toll-free once it was paid for, the bridge never has, and the City of Burlington continues to collect tolls to the present. The gracefully arched truss may be a source of civic pride, known to many as the symbolic Doorway to Burlington. But the true relationship between the City of Burlington and the MacArthur Bridge is better revealed in its nickname: the Golden Goose.

THE MISSISSIPPI RIVER

Like most river towns, Burlington has been both nurtured and stymied by the Mississippi River. The folklore associated with the great river has become ingrained in the city's history. No other river in America has touched Americans' collective psyche quite like the Mississippi. Extending from the backwoods of northern Minnesota through the middle of the nation to the Gulf of Mexico, the "Father of Waters" drains more than a third of the coterminous United States. Throughout most of the 19th century, the Mississippi served as the dividing line between East and West, between civilization and the vast prairieland that lay beyond. Functioning as an immense inland waterway, the river joined North and South, and the commerce that steamed over it supported dozens of major cities along its course. The Mississippi formed the real and symbolic heart of the Republic.

Of the three great Midwestern rivers - the Missouri, the Ohio and the Mississippi - the Mississippi is by far the largest, receiving much of its flow from the other two. The Ohio contributes 31% of volume to the lower

Mississippi; the upper Mississippi, 19%; and the Missouri 14%. Combined, these three watercourses contribute almost two-thirds of the flow through the lower Mississippi. The remainder pour in from a series of major and minor tributaries, including the St. Croix, Wisconsin, Iowa, Des Moines, Salt, White, Arkansas, Yazoo and the Red. In all, more than fifty navigable tributaries drain into the Mississippi along its twisting course through mid-America, totaling more than 14,000 miles of navigable waterways which border or traverse twenty-seven states.[1]

Although some of its trihutaries - notably the Arkansas and the Missouri - originate from the snowmelt high in the Rocky Mountains, the Mississippi is essentially a lowland river. From its source at diminutive Lake Itasca, 1,463 feet above sea level, the river first trickles through a series of deep-forest lakes in northern Minnesota and glides swiftly through other lakes past Grand Rapids, Little Falls and St. Cloud. By the time it reaches Minnesota's Twin Cities, 600 miles south, the Mississippi has dropped only 900 feet. Below St. Paul the river valley widens considerably and the river's gradient decreases. Along this stretch - in which Burlington is located - the river is bounded hy steep limestone bluffs as it flows through a relatively stable channel.

The dividing line between the upper and lower Mississippi is generally held to he the mouth of the Ohio, for it is this major tributary that almost doubles the flow of the Mississippi. For over 1000 miles below Cairo, the river meanders with a barely perceptihle current through a level flood plain from 50 to 100 miles wide. With millions of years worth of accumulated silt lining its banks, the Mississippi throughout much of this length is actually higher than the surrounding countryside. Floods along the river were legendary. During low water the lower Mississippi disgorged about 70,000 cubic feet of water into the Gulf of Mexico. During flood stage this increased more than thirty times to about 2.3 million cubic feet. In especially heavy flood years the flow increased far more as the water-choked river inundated its entire flood plain, causing hundreds of millions of dollars of property damage along its course.

At the mouth of the Missouri River, just above St. Louis, the Mississippi changed character dramatically, resemhling more the raucous tributary than its own calm upper reaches. The silt-clogged water which roiled down the Missouri entirely changed the character of the parent river, swelling it, agitating it, muddying it to a sludge-like consistency. The Mississippi beyond this point became "a furious and boiling current, a turbid and dangerous mass of sweeping waters, jagged and dilapidated shores," as gazetteer George Conclin wrote in 1852. "In its course, accidental circumstances shift the impetus of its current, and propel it upon the point of an island, bend, or sand bar. In these circumstances, it tears up the island, removes the sand hars, and sweeps away the tender alluvial soil of the hends, with all their trees, and deposits the spoils to another place."[2]

BRIDGING THE MISSISSIPPI RIVER AT BURLINGTON

As it meandered southward, the Mississippi formed an unavoidable obstacle to regional and transcontinental traffic. Several railroads in the mid-19th century had routed tracks to the river's edge and were operating ferries as the antecedents to permanent bridges. Although its flood plain was wide, the river's stable, sandy subsoil conditions would prove favorable for sinking bridge foundations, and its gentle gradient and predictable channel would allow placement of moveable spans to facilitate river navigation. The first bridge over the Mississippi was for decades also the closest to its headwaters. In 1855 a suspension bridge was completed at Hennepin Avenue in Minneapolis, Minnesota. It was a lightweight roadway structure, spanning 620 feet, with four main cables supported by wooden towers.[3]

The Hennepin Avenue Bridge was followed a year later by the first railroad bridge over the Mississippi, a timber/iron structure located at Rock Island, Illinois. The object of embittered opposition by the steamboat interests and more than one attempt to sabotage it, the Rock Island Bridge was not followed immediately by other railroad spans. The Civil War effectively halted further attempts to bridge the Mississippi for several years. At war's end, several railroads began plans to span the river in a number of locations as the gateways to their projected westward expansion.

To insure unimpeded navigation on the river, Congress in 1866 passed the River and Harbor Act, which stipulated "examining and reporting upon the subject of constructing railroad bridges across the Mississippi between St. Paul and St. Louis upon such plans of construction as will offer the least impediment to the navigation of the river." Additionally, Congress authorized construction of bridges over the Mississippi at Winona, Dubuque, Burlington, Keokuk, Quincy, Hannibal and St. Louis and specified minimum horizontal and vertical dimensions for the structures:

> **If built as high bridges, they should be 50 feet above extreme high water, with spans not less than 250 feet in length, and one main or channel span not less than 300 feet in length; if built as draw bridges, they should have two draw openings of 160 feet in the clear, and the next adjoining spans should not be less than 250 feet and should be 10 feet above high water and 30 feet above low water.** [4]

With this approval, the Chicago, Burlington and Quincy [CB&Q] Railroad moved immediately to bridge the river at Burlington and Quincy. The Burlington location was ideal. The central district of the town was located primarily on a small plateau at the mouth of Hawkeye Creek, with outlying residential development spread out on the high ground on the bluffs. This would allow easy

river-level entry into the town, using a low, swing-span bridge configuration. The Mississippi here flowed almost due south, curving slightly southwest below the city. For several miles above and below Burlington it followed the 300-400' limestone bluffs on the west (Iowa) shore, producing a stable and predictable channel with a low water width of about 2,000 feet. An extensive bottomland lay east of the river for seven or eight miles. This formed a labyrinth of bayous and old channels, which were overflowed over its entire width in flood stage. The slope of the river at low water was only about 0.27 feet per mile, producing an almost imperceptible current. The river stage here fluctuated some twenty feet between low and high water, and its velocity ranged between two and five miles an hour.[5]

CB&Q Chief Engineer Max Hjortsberg had begun investigating the river at Burlington in 1865, before the Congressional authorization was secured. After numerous consultations with other engineers, he laid out the bridge's center line over the frozen river in January 1867 and determined its span lengths. Hjortsberg located the structure near the railroad's existing transfer ferry, about a mile downriver from the public landing. The sandy riverbed would allow driven pile foundations, rather than the more expensive, dangerous and time-consuming pneumatic caissons necessary on the silt-floored Missouri and the lower Mississippi rivers. Full-scale construction on the piers began that summer. After working throughout the following autumn and winter, the masons laid the last stone on the cylindrical pivot pier on March 3, 1868, two days before the winter ice pack began to break up. The Detroit Bridge and Iron Company fabricated and erected the bridge's eight fixed Whipple trusses and 356' swing truss. Ceremoniously opened to traffic on August 13, 1868 - only months before the Dubuque and Quincy structures - the Burlington Bridge was the first all-metal span over the Mississippi River.[6]

Costing almost three years' time and approximately $1.25 million to build, the bridge had a profound effect on Burlington's development. As the trunk line for a major Midwestern railroad and one of only a handful of spans over the Mississippi, it attracted a substantial volume of rail traffic, which brought with it prosperity to the city. But the single-track bridge - and its wider 1893 replacement - was designed to carry rail traffic only. For decades to follow wagons, pedestrians and stock had to rely on a series of ferries to cross the river at this point.

Over the next forty years residents of Burlington agitated and schemed sporadically for a vehicular bridge across the Mississippi to link the city with the rich agricultural market in western Illinois. In 1887 a group of local businessmen formed the Burlington and Illinois Bridge Company to build the wagon bridge. The city's hopes were buoyed as the *Burlington Hawk-Eye* stated confidently:

> **The company is now thoroly** [sic] **organized and the work of procuring the charter will be prosecuted as rapidly as possible, after which surveys and estimates will be obtained and the work of construction**

will be undertaken. With the improved appliances now in vogue in bridge construction the structure can easily be completed in one year... There is no doubt whatever of the financial ability of these gentlemen [the incorporators] **to make the enterprise a success.** 7

The bridge company failed soon thereafter. The city then turned to the Chicago, Burlington and Quincy railroad in an attempt to convince the latter to build a combination railroad/wagon bridge near its existing swing-span structure. The plan as envisaged by Burlington businessmen involved erection of a high, fixed-span bridge that would connect with Market Street. The railroad would reroute its tracks to the new higher grade and construct an extensive viaduct through the city. Though advantageous for Burlington, the proposal promised to be costly and redundant for the railroad and was ultimately rejected.8 The city then listened to R.O. Marsh, who proposed to build a river-level railroad from St. Louis north through Burlington. The track would cross the Mississippi at Burlington on a combination bridge, to be funded jointly by the city and the railroad. Marsh's plan also failed to materialize.9 Numerous other programs were proposed and, with insufficient support and capital, discarded. It would not be until 1914 that the movement for a wagon bridge would garner enough support for success.

J.A. MacARTHUR AND THE BURLINGTON COMMERCIAL EXCHANGE

Since Burlington's first major development in the mid-1850s, its commercial interests had formed self-promotional organizations. The first of these was the Burlington Board of Trade, incorporated in December 1855 by several noteworthy local businessmen.10 The Commercial Club of Burlington was later chartered in 1887.11 Patterned after the Commercial Clubs of Chicago and Cincinnati, its membership was comprised of many of the same businessmen who had incorporated the abortive Burlington and Illinois Bridge Company that same year.

In March 1899 prominent Burlington businessmen Charles Armkneht, Carl H. Schlapp, N.R. Derby, B.F. Kuhan, and J.S. Edwards incorporated the Burlington Commercial Exchange. Successor to the earlier organizations, the Commercial Exchange was created "to promote the business interests of Burlington and to adopt such means as will best secure this result."12 Like the others, it was comprised of Burlington's professional and commercial elite and soon became the city's most powerful promotional organization. By 1915 the Exchange boasted a roster of more than 200 Burlington businessmen. Though formed initially to function as a chamber of commerce, the Commercial Exchange would eventually

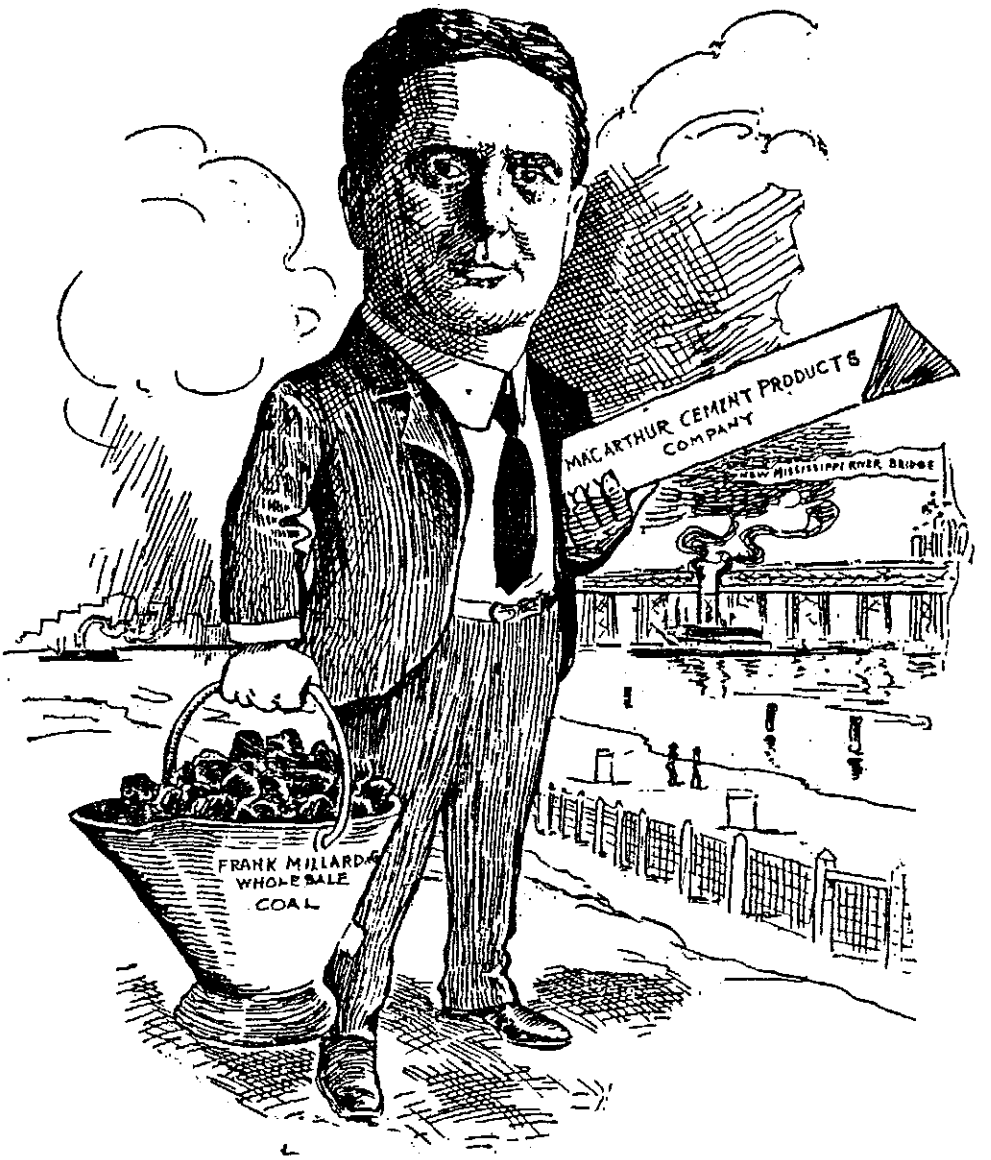
become the driving force behind the movement to build the wagon bridge.

One influential member of the Commercial Exchange was Burlington businessman J.A. MacArthur [1869-1939]. Born in Detroit on September 25, 1869, John Alexander MacArthur spent his youth with his family in Canada. There he was for a time employed as a clerk and later branch manager for the Bank of Toronto. MacArthur married Emma Millard, daughter of prominent Burlington businessman Frank Millard, in 1898, and the couple returned to live in Canada. They moved to Burlington two years later when MacArthur was thirty-one. He soon entered into a partnership in the wholesale and retail coal business with his father-in-law. Using funds provided primarily by Millard, the two men bought out the existing business of W.B. Hosford on Market Street and renamed it Frank Millard and Company. With MacArthur as its aggressive managing partner, the company expanded rapidly from a minor firm with only two delivery wagons in 1901 into the largest coal supplier in the city five years later.[13] He later ventured into cement and lime sales and conducted this business under the name of the MacArthur Cement Products Company. Residing in an expansive Victorian house on a bluff overlooking the Mississippi River, MacArthur was for decades a prominent figure in Burlington business and social circles. *[see fig. 1.]*

As an active member and former president of the Commercial Exchange, MacArthur attended the organization's meetings regularly. Often when the discussion lagged, the "modern Cicero, with the aspirations of an Horatio" would speak at length about the need for a permanent wagon bridge to connect Burlington with western Illinois.[14] Finally, in 1913 Exchange president Ed Gould, reportedly tired of hearing MacArthur's speeches in behalf of the bridge, appointed him as a one-man committee to investigate the feasibility of the plan. MacArthur immediately refused, but agreed to serve as committee chairman if Gould would allow him to appoint four other Exchange members to serve with him.[15] This was all MacArthur needed.

He immediately began studying the performances of other existing toll bridges and means of financing a bridge at Burlington. In November MacArthur approached the Exchange with a request to hire a civil engineer to survey possible bridge sites and prepare cost estimates. The group agreed unanimously, and MacArthur hired the Wisconsin Bridge and Iron Company to conduct the study.

In January he reported favorably to the Commercial Exchange on the prospects for a wagon bridge at Burlington.[16] MacArthur related the successes of three other similar Mississippi River toll structures: the bridges at Fulton, Muscatine and Clinton. The Lyons and Fulton Bridge had taken in between $9,000 and $10,000 per year in tolls in each of its twenty years of operation. Open for some 23 years, the Muscatine High Bridge had averaged $9,000 per year over its service. In the previous two years, since the bottomlands on its eastern side had been drained, the bridge had grossed more than $12,000 per year. The Clinton High Bridge had been open as long as the Muscatine structure and had demonstrated a profitable return on investment every year. Based on the other bridges' records, maintenance costs (insurance,



J. A. MacARTHUR.

HERE is this clever man, "Mack,"
Whose business instinct's never slack.
He sells us our coal—
Puts posts in a hole;
Builds a bridge every day,
Just as easy as play;
Has an idea or two—
Turns them over to you;
And insists, with a smile,
That in progress, meanwhile,
Burlington should have a clear track.

Figure 1 (taken from *Burlington Hawk-Eye*, c. April 1915.)

toll collectors' salaries, painting, repairs, etc.) could be expected to average $3,000 per year, leaving a substantial net return with which to retire any construction debts.[17]

Moreover, the nearest vehicular crossing upriver from Burlington was at Muscatine, about sixty miles north, and downriver, at Madison (on the Atchison Topeka and Santa Fe Railroad bridge), about twenty miles south. This would place Burlington in the advantageous position as the only crossing for some eighty miles along the Mississippi. Built in the 1890s, the other bridges were beginning to show some wear; the Burlington structure would be the first highway-only crossing constructed over the Mississippi since the Eagle Point Bridge north of Dubuque was completed in 1901. With a permanent bridge Burlington could expect to be included on one or more of the regional highways then developing: roads such as the Burlington Way between St. Louis and St. Paul and the Bluegrass Route from Burlington across Iowa to Council Bluffs. Finally, MacArthur could point to the amount of traffic already crossing the Mississippi at Burlington, without benefit of the bridge. The ferry had handled more than 2,000 automobiles during the previous year, and some 87 wagons had crossed on the ferry in one day during the summer.[18] To J.A. MacArthur, at least, the need for a bridge was evident.

THE CITIZENS' BRIDGE COMPANY

After reporting to the Commercial Exchange, MacArthur went a step further and actually formed a company to finance, build and operate the proposed structure. Called the Citizens' Bridge Company, it enlisted many of the members of the initial study committee as officers: George C. Boesch, vice president; J. Lyman Edwards, treasurer; and Commercial Exchange secretary Ed Egan, secretary. MacArthur, himself, would serve as president.

Before actual construction could begin on the bridge, the new company would have to pass several hurtles. The first of these was official formation of the company itself. On February 6, 1915, the Citizens' Bridge Company was organized. Four days later the directors received certificates of incorporation from the Iowa Secretary of State.[19]

The next obstacle was to raise enough money to build the bridge. To accomplish this, MacArthur devised an unusual and innovative plan, which combined a corporate stock and bond offering with a municipal tax. The corporation authorized a capital stock offering of $150,000 in $100 shares: 1,250 shares of preferred stock, 250 shares of common stock. To distribute the common stock over as wide a popular base as possible, the directors limited its subscription to one $100 share per person.[20] The remainder of the estimated

$180,000 construction cost would be raised from bond sales and taxes levied by the City of Burlington. The preferred stock would be issued to the city on a dollar-for-dollar basis in return for the tax money. As its name implied, the bridge company was to function more as a citizens' collaborative than as a private corporation. MacArthur's intention was to build and operate the bridge as a privately held structure, collecting tolls until the cost of its construction could be defrayed. At that point the City of Burlington would acquire it, and the Citizens' Bridge Company would then be dissolved.[21] MacArthur included two provisions in the articles of incorporation whereby the city could do this. The first would be to buy and retire the outstanding stock, at par value plus 6% accrued interest, assume all liabilities and pay off the bonds. The alternative was to allow the corporation's sinking fund to reach a point at which the indebtedness could be retired and title taken to the holdings of the corporation. According to MacArthur, "Never was a cleaner proposition put up to a city, or between man and man."[22]

The stock subscriptions sold quickly in early 1915. And it appeared that the Congressional charter for the bridge company would be secured easily within weeks.[23] A popular election was necessary, however, to approve the municipal tax. The law required about 3,500 petition signatures: a majority of the resident property owners.[24] To achieve this, the bridge company began an aggressive advertising campaign and sent out representatives to canvas the neighborhoods for signatures. On May 20th a 5,000-signature petition was presented to the Burlington City Council. "There seems to be a misapprehension among some of our people who declare that Burlington will never own the structure," MacArthur said to the Council. "We are holding nothing back. The bridge will be owned by the city. The city will never be so poor that it wouldn't be able to purchase the common stock and own the bridge, which it can do by giving 30 days' notice. There are no strings attached, and there is no nigger in the woodpile."[25]

The election was scheduled for June 30, 1915. But even MacArthur's considerable enthusiasm could not overcome the skepticism of a city that had listened to numerous bridge plans over the preceding forty years. The *Hawk-Eye* reported on the temporary ice bridge across the Mississippi, summing up the city's cynicism about securing a permanent wagon bridge:

> **There is more or less interest manifest in the latest bridge project, which is being fathered by the Commercial Exchange. And in consequence, many people ought to be getting interested in the excellent ice bridge which now furnishes safe and cheap and convenient communication between the two shores of the big river. There are but two great factors in the prosperity of Burlington, a bridge aeross the river and good roads. Another is that our working people must be employed. When we have all these different things pulling together for Burlington, we have real prosperity here. Strange, that after all these years of discussions, we know no more than we did fifty years ago, about this road proposition.**

Fifty years ago, the Hawk-Eye stated that the Ice bridge was in perfect condition and the roads were good, and that therefore the Burlington merchants were quite husy. Perhaps the people had a clearer idea of the importance of good roads fifty and sixty years ago than they have today. The fact that they huilt plank roads surely shows that they knew the importance of a road that was always In good condition. And all the arguments that have been made regarding the hridge problem these past thirty years have added nothing to the sum of our knowledge fifty years ago, which was briefly expressed in that the merchants were husy hecause we had an excellent hridge across the river at this point. 26

The ballot had been divided into two questions. The first sought approval for a tax levy of 2% on assessed valuation of property; the second sought authorization for the Citizens' Bridge Company to build the bridge. Both proponents and opponents of the bridge lobbied vociferously before the election. The bridge proponents, led by J.A. MacArthur, were more organized, however. MacArthur spoke regularly for the bridge. The *Hawk-Eye* and the *Gazette* printed editorials explaining the provisions of the bridge company's charter. Even the venerable Commercial Exchange opened its meetings to the public to allow another avenue for persuasion. Although women's suffrage had recently suffered a setback in the Iowa state house, bridge supporters discovered a provision in the state code that would allow the women of Burlington to vote on the taxation issue, if not the bridge authorization. The bridge supporters courted the women's vote actively.27

On election day, bridge supporters used almost every available wagon and car to bring voters to the polls. The turnout was heavy and overwhelmingly in favor of both propositions - by a margin of almost 5 to 1.28 "The women did it!" was the disgruntled reaction of the opposition, and apparently they did. But the men certainly went along with them.

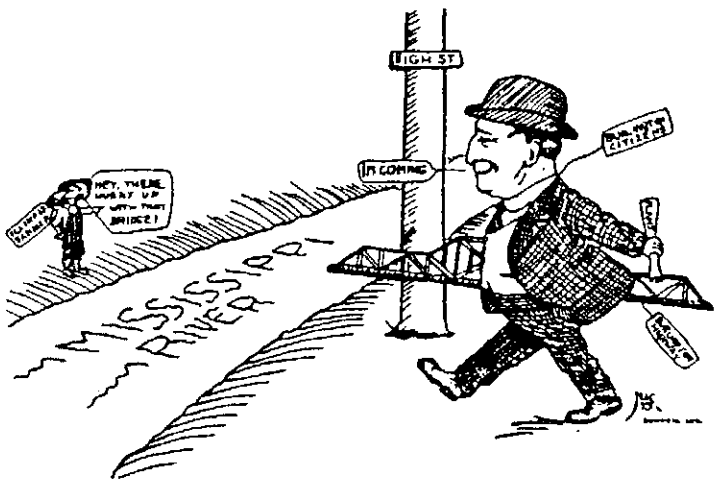


Figure 2 (taken from *Burlington Hawk-Eye.*)

THE WISCONSIN BRIDGE AND IRON COMPANY

After the election returns were counted, the city turned to MacArthur to build the long-awaited bridge. In August 1915 he in turn contracted with the Wisconsin Bridge and Iron Company [WB&I] to engineer, fabricate and build the structure. The contract was structured on a cost plus percentage basis, with a ceiling of $195,000, and was contingent upon the ability of the Citizens' Bridge Company to secure a charter from the government. Under the terms of the agreement, WB&I would have a year from the time that MacArthur gave notice to proceed.[29] As it turned out, the company would need every bit of that time, and more, to erect the immense structure.

Again MacArthur faced heated criticism - this time for his handling of the contractor selection. Some in town felt that he should have awarded the contract only after soliciting competitive bids. He countered, saying that the bidding process would have added at least $2,500 to the cost of steel and the project would have been delayed by at least one year.[30]

Despite the criticism, MacArthur's choice of Wisconsin Bridge and Iron was a conservative one. Based in Milwaukee, the 30-year-old company was a well-established regional bridge fabricator and erector that could claim an extensive portfolio of major bridge commissions. WB&I was the 19th century creation of German-born Friederich and Berthold Weinhagen. Immigrating to the United States at age 16 sometime after the Civil War, Friederich E. Weinhagen settled in Milwaukee. By 1886 he was employed as a regional agent for the Penn Bridge Company of Beaver Falls, Pennsylvania. Weinhagen built at least one bridge under his own name at this time, in addition to his work for Penn.[31] By the following year he had formed the Wisconsin Bridge and Iron Company with his brother Berthold.[32] In January 1891 the two Weinhagens incorporated the company with Herman Wagner and William Hinrich. Claiming capital stock of $100,000, WB&I contracted for construction of iron railroad and highway bridges and manufactured roof trusses and structural iron work.[33] Friederich Weinhagen remained active with the company until resigning in 1910 to become president of the A. George Schultz Company, a Milwaukee paper and box manufacturer. He reportedly retired a millionaire in 1919 and returned to Hildesheim, his home town in Germany.[34]

Wisconsin Bridge and Iron was one of the few major Midwestern bridge erectors to escape Andrew Carnegie's industry-wide consolidation of bridge firms into the American Bridge Company in 1900. Pointedly advertising "Not in any Trust," the prolific company was able to compete with its powerful rival, at least on a regional basis. In 1904 the stockholders approved a threefold expansion of capital stock to $300,000.[35] Business continued to expand steadily in the ensuing years; by 1910 the corporation's value had increased to $500,000.[36]

Figure 3 (taken from *Engineering News Supplement*, 24 June 1909)

Though better known for its simply supported Pratt roadway trusses, Wisconsin Bridge and Iron had completed two bridges over the Mississippi River when J.A. MacArthur approached the company to build Burlington's structure. The first was the famous Spiral Bridge at Hastings, Minnesota. Built under authorization granted by Congress in 1894, this highway truss featured a simply supported 375' channel span that was accessed from Hastings by a novel spiral entrance ramp. WB&I chief engineer John Geist engineered the innovative structure.[37] The company also built the replacement bridge for the Chicago and North Western Railroad at Clinton, Iowa. Completed in 1910, the multi-span truss reportedly incorporated the longest riveted fixed span then on the C&NW system.[38]

DESIGNING THE BRIDGE

Wisconsin Bridge and Iron vice president J.F. Jackson was responsible for designing and fabricating the superstructure for the Burlington bridge. Jackson had conducted the preliminary studies the year before and was familiar with the requirements for this site. The construction drawings drafted by the firm in late 1915 and early 1916 showed a multi-span steel truss that used industry-standard configuration and detailing. The total length of the structure was 2,555 feet, 2,463 feet of which involved steelwork. This was comprised of simply supported deck truss and girder approach spans, with a long-span cantilevered through truss held high over the main channel of the Mississippi by thin concrete piers.

The cantilever design and high configuration of the bridge, though greatly different from the railroad bridge at Burlington, conformed closely to general engineering practice of the time and to precedents set by earlier vehicular bridges over the Mississippi. The techmque of building out from either end of a bridge and joining at the middle is an ancient one. In principle a cantilevered beam or truss distributes stresses in much the opposite way as does a comparable simply supported structure. Held aloft at both ends by piers

or abutments, a simply supported bridge deflects downward toward the middle when loaded so that the lower chord is convex under a positive bending moment. A cantilever bridge, on the other hand, is supported at only one end and must therefore be counterbalanced by a second member extending in the opposite direction from the pier. A cantilever span bends so that the upper surface is convex in a state of negative bending. The distribution of tensile and compressive forces is therefore reversed. In a simple truss the top chord is in compression and the bottom in tension; the top chord of a cantilever truss is in tension and the bottom chord in compression.

The distribution of the bending moment is also reversed. The maximum bending occurs at mid-span on a simple truss and at the anchored end, over the support, on a cantilever. As literal manifestations of stress analysis, trusses reflect this with eloquent simplicity. Polygonal-chorded simple trusses are deepest at the center, placing the greatest cross-section of steel to resist the greatest bending moment. Conversely, the web depths of cantilever trusses tend to be greatest at the piers.

Cantilever trusses built in the 19th century were related to each other more in method of construction than in web configuration, and as a result they displayed a wide array of shapes, especially in the formative years. The first large-scale cantilever bridge built in America was the Kentucky River Bridge of the Cincinnati Southern Railroad, erected from a design by Charles Shaler Smith and L.F.G. Bouscaren in 1876-77.[39] Built using mathematically demonstrable but practically untried principles, the bridge was an innovative and dramatic structure - "a work of science without concession," according to architect Louis Sullivan. Other major cantilevers soon followed, with increasingly longer spans. These included the 470'-span Niagara River Bridge [1883] by Charles C. Schneider, the 548' Poughkeepsie Bridge [1888] by Thomas Curtis Clarke, the 551' Tyrone Bridge [1889] by John McLeod, the 660' Red Rock Bridge [1890] by J.A.L. Waddell, the 790' Memphis Bridge [1893] by George S. Morison, and, climactically, the 1800' Quebec Bridge [1907] by Theodore Cooper.[40]

By the time the latter bridge was completed, at least 32 major cantilevers had been erected in America, 22 of which exceeded 400' in span length.[41] Cantilever bridges typically had three spans: a main center span (comprised of two cantilever arms that held a center suspended span), with an anchor span at either end. These were usually found in through truss configuration, although cantilevered deck trusses were also built with regularity.

Built in locations that made falseworks impractical or that required extremely long spans, cantilevers also had significant drawbacks. They were by nature less rigid than simple trusses, limiting their use primarily to highway bridges.[42] They also tended to cost more to erect than simple trusses. Bridge engineer J.A.L. Waddell, who had himself designed the Red Rock cantilever, criticized this bridge form harshly, saying:

> **About the time that cantilevers came into vogue, certain bridge designers entertained a wild idea to the effect that the new type**

involved some special virtue or feature of excellence or else that it was economic at first cost; because many cantilever bridges were built in places where simple-span structures would have been far better and cheaper. Possibly the thought of establishing an innovation induced some of the designers of those bridges to prefer the cantilever type to that of the simple truss. What a pity it is that such designers did not devote their time and energy to an attempt to introduce the steel-arch bridge into American practice! Had they done so, probably they would have been successful; because there is so often true economy in the arch - besides it is far more aesthetic than either the cantilever or the simple truss. A long-span, cantilever bridge can be made agreeable to the eye by using artistic outlines and a well-studied web-system; and, again, its simple vastness produces a pleasing impression upon the beholder; but a small-span cantilever is ugly and causes a trained intelligence to propound to itself the question "why and wherefore?" without receiving a satisfying answer. [43]

Cantilevering suited itself well to bridge construction on the Mississippi River. Congress had required that each bridge over the river be either a low-level, moderate-span structure with a moveable truss over the main channel, or a high, fixed-span bridge with relatively long spans. Faced with severe limitations on the grades of their bridge approaches, railroad engineers almost always designed river-level structures to cross the Mississippi. Additionally, rail traffic tended to be intermittent, allowing the railroads to operate swing-span bridges efficiently. But for vehicular bridges, which carried continuous traffic and which could use much steeper approaches, the engineers preferred fixed spans held high over the river. Cantilevering these structures allowed them to design relatively long, fixed-span trusses that were materially conservant. Further, by eliminating the need for falseworks over the Mississippi's main channel, the engineers could avoid obstructing river navigation and could erect the superstructures largely without concern for the highly changeable conditions on the river below.

The first highway bridge over the Mississippi below the Twin Cities was a cantilever truss. Designed by Horace E. Horton and completed in 1887, this sinewy iron structure spanned the river at Dubuque, only 75' downriver from the 1868 swing-span bridge of the Illinois Central Railroad. The Dubuque High Bridge incorporated a cantilevered 363' channel span positioned over the swing of the railroad bridge. This was balanced on both sides by 248' anchor spans. According to Horton, the Dubuque bridge "marked an epoch in bridge matters, in the fact that the lesser commercial interests of a wagon bridge justified the outlay."[44]

Three other cantilever trusses over the upper Mississippi followed within five years. The toll bridges at Muscatine and Clinton were both engineered by George T. Baker. Built by the Milwaukee Bridge and Iron Works in 1890, the Muscatine High Bridge consisted of a 442' channel span with 360' anchor spans.

The Clinton High Bridge was completed a year later by the Clinton Bridge and Iron Works. Its channel span extended 420', anchored by 210' spans on either side.[45] Without question the most distinctive of the early structures was the highway bridge at Winona, Minnesota. Authorized by Congress in 1890, it was built for the City of Winona by the Chicago Bridge and Iron Company in 1894.[46] Like the Dubuque structure it was designed by Horace Horton and featured his trademark gracefully curved chords on the 360' cantilevered span. The Winona structure had a far more eccentric profile than its predecessor, however, with an oddly configured semi-deck approach truss over the east shore and main truss end posts that dipped dramatically below the roadway deck to low stone piers.[47]

The *Burlington Gazette* felt that the proposed Citizens' Bridge was odd looking as well, describing it as "somewhat peculiar in type."[48] But in reality the proposed bridge fit well within the mainstream of cantilever design for the time and was technologically unadventurous in both dimensions and detailing. Like the four other cantilever highway trusses built over the Mississippi, the Burlington bridge consisted of a series of simply supported approach spans that led to a cantilevered main span over the navigable channel. The main span for the Burlington bridge carried the roadway in a through configuration, with approach gradients ranging between 3% and 4% and a slight camber in the cantilever arms. Moreover, it spanned 480', with 260' anchor spans: only slightly longer than the channel spans on the other bridges.

The greatest differences between this and the earlier trusses lay in its method of assembly and its design strength. The other structures all employed pinned connections as the prevailing technology in the late 19th century. Pinned connections had largely been superseded by field riveting in the intervening 30 years; the Citizens' Bridge would use riveted connections. Built to carry trolleys and heavier vehicles than the four earlier structures, the bridge at Burlington also employed more substantial truss members and floor system, with greater bracing and heavier connections.

As delineated by Wisconsin Bridge and Iron, the west approach ramp to the Citizens' Bridge began at High Street in Burlington. At the juncture with High Street the road was supported by 90 feet of earth fill, held in place by retaining walls. Beyond this were eight plate girder spans, from 30 to 66 feet in length, supported by steel bents. A 140' Pratt deck truss began the bridge proper. The outer end of this span was carried by Pier No. 2, which also supported the 260' west anchor arm of the cantilevered span. The main channel span was composed of two 132-foot cantilever arms, carrying a 216' suspended span. Beyond the east anchor arm was a series of deck truss approach spans, ranging in length from 175' to 120'. These were joined by another series of plate girders that extended to the Illinois shore. With grades of 3% to 4% over most of the the bridge's length, the engineers were able to develop a 56' to 57'6" vertical clearance over low water at the center of the channel span.[49] *[see fig. 4.]*

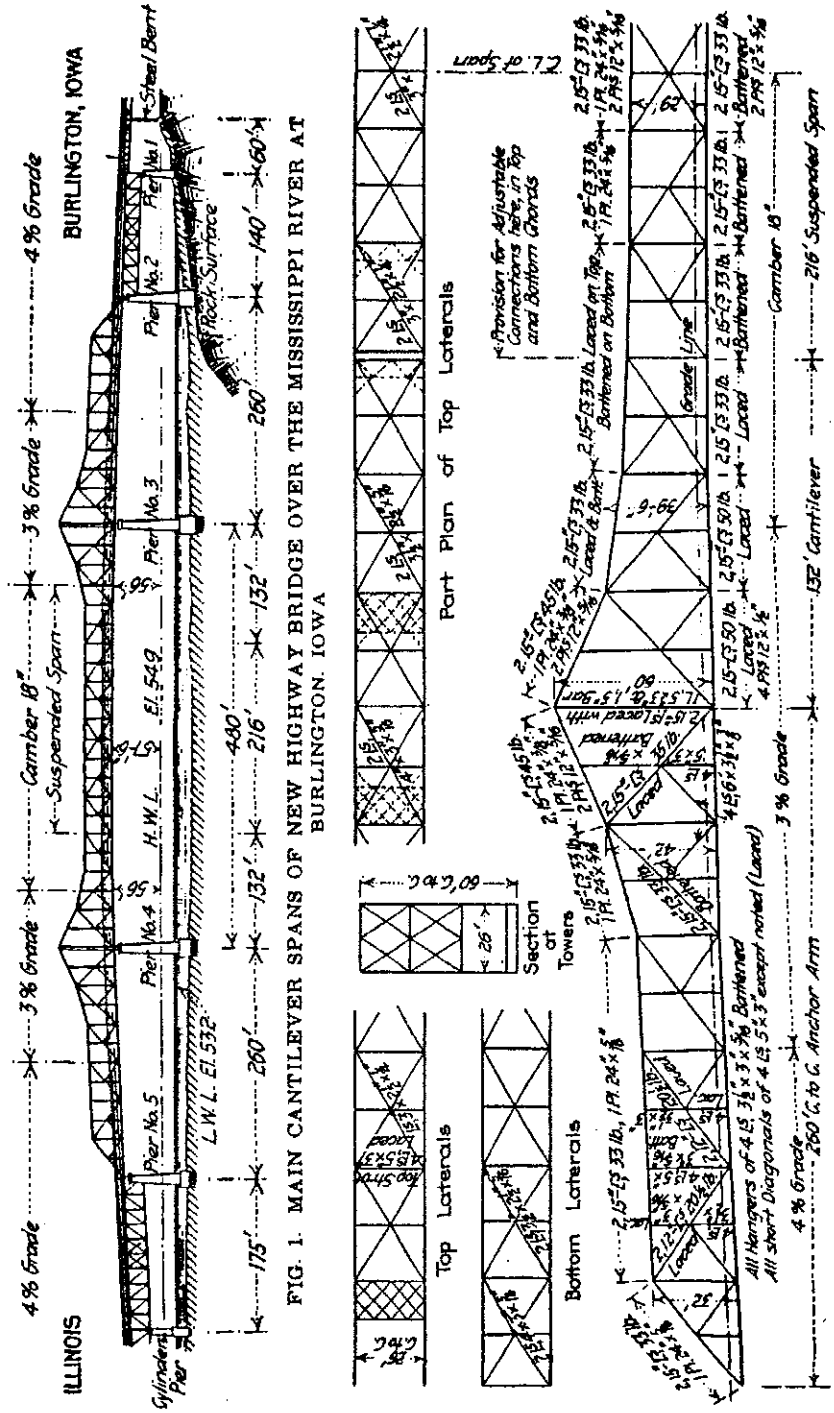


FIG. 1. MAIN CANTILEVER SPANS OF NEW HIGHWAY BRIDGE OVER THE MISSISSIPPI RIVER AT BURLINGTON, IOWA

Figure 4 (taken from *Engineering News*, 22 March 1917.)

The trusses and girders were supported by a variety of piers, reflecting the differing superstructural and subsoil conditions. The west approach girders were supported by 12" Bethlehem girder columns, founded on bedrock. These were battered with a 1:12 slope and connected into bents by struts and diagonals. Concrete-filled, steel cylinder piers carried the east approach girders and deck trusses. These were used as an economical means to distribute the loads across the soft sands that floored the Illinois riverbank at Burlington. Each pier was comprised of a pair of 4' or 5' diameter tubes, built of 5/16" steel plates. These cylinders were telescoped into larger, 3/8" plate cylinders, which extended 143' to 19', with their tops 7' above low-water line. Each of these lower tubes rested on the caps of eleven 35'-long timber piles. The pairs of cylinders were braced by girders or angle struts, with angle diagonals. *[see fig. 5]*

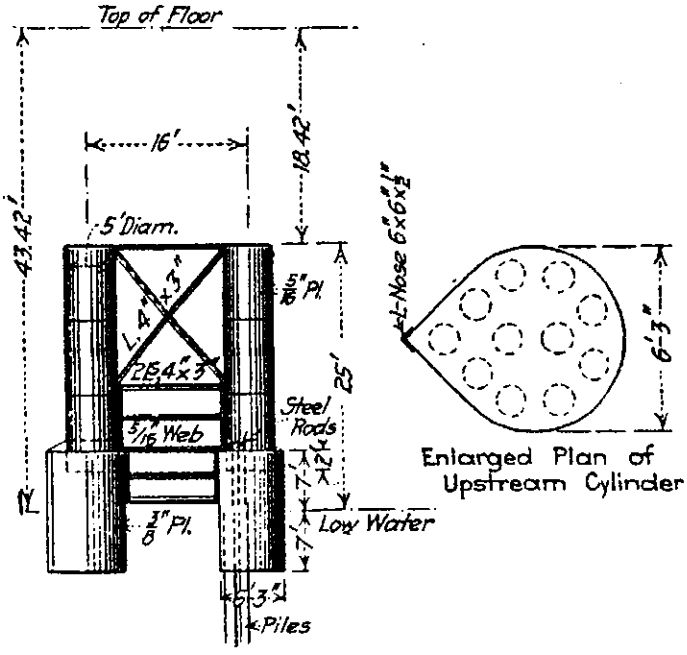


Figure 5 (taken from *Engineering News*, 8 March 1917.)

Given that the president of the bridge company owned the largest concrete company in the city, it is not surprising that the main channel piers were made of reinforced concrete. The foundations of these consisted of heavy timber cribs set on timber piles, truncated eight feet below low-water level. Above the high-water level each pier was configured as a pair of concrete pedestals, paneled on three sides and joined by a 12" thick concrete diaphragm. Steel rods and angles reinforced the pedestals. *[see fig. 6]* Piers No. 2 and 5, which also carried deck trusses, featured diaphragm walls that were much thicker up to the bearing points of the approach spans. Pier No. 1 supported

a deck truss and a girder and was therefore comprised of two 43'-tall pedestals joined by a diaphragm only at the top and bottom.

The engineers used typical dimensions and detailing for the trusses of the Burlington bridge. The webs of the through truss were spaced 26' on center and had a depth of 29' in the suspended span, 32' in the parallel chord sections of the arms and 60' at their deepest point over the piers. *[see fig. 7]* The weight of the three through spans was about 1.6 million pounds; the total superstructural weight, 3.4 million pounds.[50]

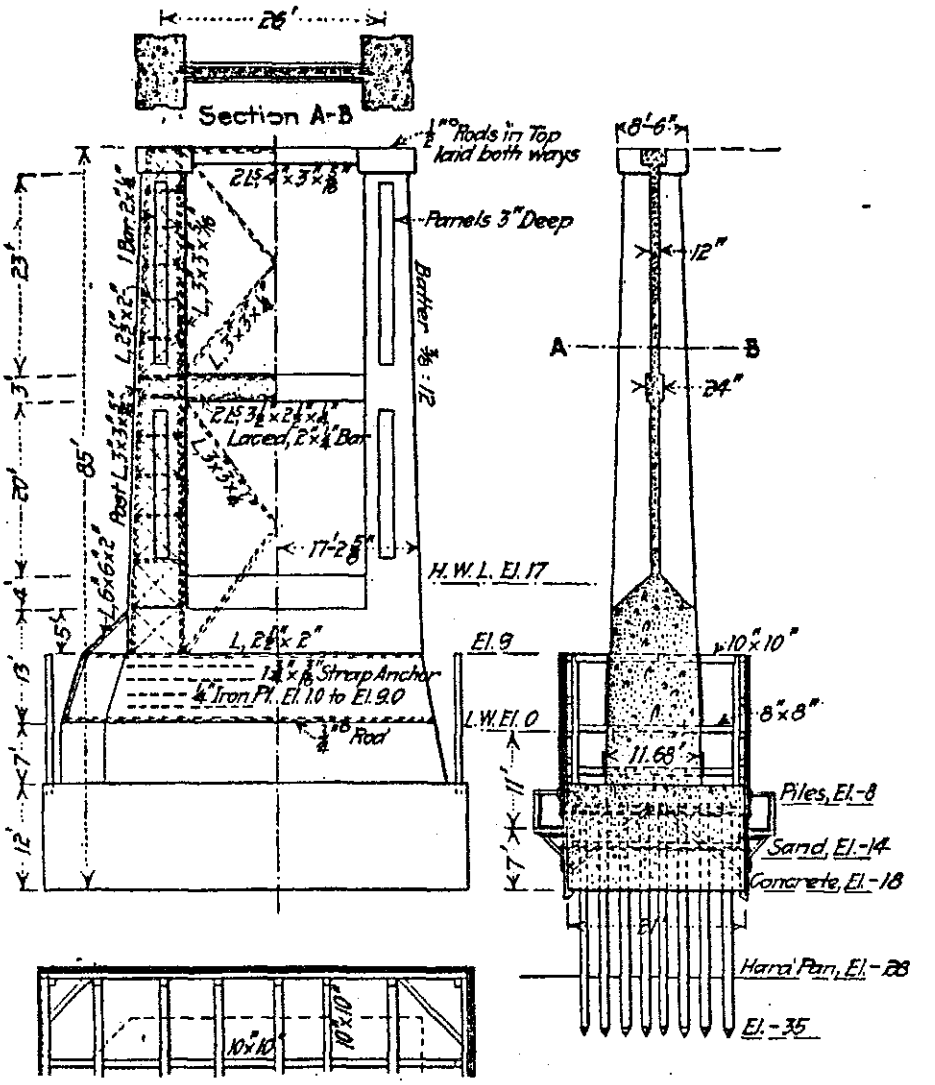


Figure 6 (taken from *Engineering News*, 7 March 1917.)

Intended to carry interurban trolley cars as well as wagon and auto and foot traffic, the bridge carried a 20' roadway and 4' sidewalk. These were supported by nine rows of 10" and 12" channel and I-beam stringers. The roadway floor consisted of a lower course of 3-1/2" creosoted planks, laid with 6" spaces, spiked to wood strips bolted to the webs of the stringers and overlaid with a wearing surface of 2" oak plank. The sidewalk consisted of a single course of 3" plank. The trolley tracks, if installed, would be laid next to the sidewalk, near the center of the bridge.

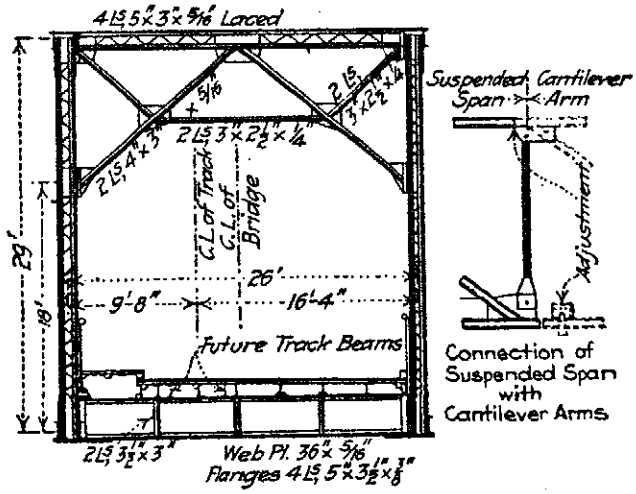


Figure 7 (taken from *Engineering News*, 22 March 1917.)

The engineers designed the trusses to support a live load on the roadway of 2,000 pounds per linear foot. This would be sufficient to carry a 15-ton road roller or a 40-ton trolley with a 30-ton trailer, with the loads placed on the various spans, for design purposes, to create the maximum stress on the truss. The live load on the sidewalk was computed as 100 pounds per square foot. The lateral loading from the wind as 20 pounds per square foot of exposed surface. The dead load - exclusive of the weight of the deck - was calculated by the engineers at about 2,200 pounds per linear foot for the cantilever arms and 1,850 pounds for the suspended span.[51]

The cantilevered spans used riveted connections throughout, except for the pinned connections used to join the suspended span. The upper and lower chords were generally comprised of pairs of 15" rolled channels, joined either with lacing or batten plates; some of the more critical members were reinforced with 24" cover plates and 12" side plates. The towers over the piers were made up of pairs of 15" Bethlehem girder I beams, spaced longitudinally at 3 feet on center and laced with 3"x 3" steel angles. The truss verticals, diagonals and struts were comprised of four angles or two channels, depending on location, either laced or battened. The diagonals extended over two panel lengths and were stiffened by sub-struts. Plate-girder floor beams were framed between the

lower ends of the verticals, at the lower chords, and transverse struts between the upper ends. The top and bottom lateral bracing extended over two panel lengths.

The deck trusses were detailed like the channel spans, with riveted connections and built-up components made of rolled steel sections. The top chords consisted of two channels with cover plates (two angles at the end panels). The bottom chords were comprised of four angles with cover and/or batten plates. The verticals and diagonals were made up of two or four laced angles. The relatively steep gradient of the bridge deck and the need for economy pushed the WB&I engineers into a couple of interesting design solutions. To keep the bottom chords of the east approach spans above the high water level and accommodate a sloped roadway, they configured the bottom chords with a stepped, polygonal profile. Additionally, they decreased the span lengths of the trusses from 175' to 140' to 120' under the descending roadway to reduce the trusses' web depths near the shore. This created an ungainly and asymmetrical appearance, which was balanced somewhat by the similarly shaped west approach span and offset by the strong visual impact of the main cantilever through span.

BUILDING THE BRIDGE

The Citizens' Bridge Company secured the approval of the War Department for the proposed bridge in the summer of 1915. On December 16th, Congress authorized its construction. President Woodrow Wilson signed the legislation two days later.[52] On December 27th, only four days before its option with WB&I was due to expire, the Citizens' Bridge Company issued the notice to proceed with the construction.[53]

Given the enormity and complexity of the project and the unpredictable nature of the Mississippi River, construction of the Citizens' Bridge progressed at a smoothly choreographed pace. The contract with WB&I called for a completion deadline of December 27th, 1916, one year after the Citizens' Bridge Company issued the notification to proceed. To speed the construction, WB&I in turn subcontracted with the Green Construction Company of Green Bay, Wisconsin, for the substructural work. Many Burlington observers remained doubtful that the contract could be fulfilled, however, predicting that it would take as long as twenty years to complete the huge structure.[54]

Actual construction began on April 4th. Local contractor Henry Eilers began the work by building the retaining walls on High Street between Main and Front. Two weeks later materials began pouring to the site as the men readied the equipment. The *Gazette* described the initial activity:

Heavy shipments of hridge tlmbers have been received during the past few days hy the new hridge contractors and work on the driving of the plling will commence with the arrival of a shlpment of lumber from St. Louis. The hlg plle driver has been located on the barge which will be its restlng place during the summer, and one of the lumber barges was towed into Burlington from Rock Island hy the steamer Black Hawk yesterday. Locating the plle driver and derrick on the hridge was a difficult and tedious operatlon. It was necessary to turn the barge lengthwise to the shore and run tracks directly onto the deck. The derrick was then run ahoard and made fast. Piles for the launchway have been driven during the past few days to facllltate work during the bridge building operatlons. 55

After some initial delays due to the high spring water level, full-scale work on the river began on July 1st. Adolf and Herman Green, the father and son managers of Green Construction Company, supervised the forty to fifty men who worked on the site, dredging, constructing coffer dams and cribs, pile driving, building and knocking down wood forms and pouring concrete.

The crew excavated for Piers 1 and 2 - both located in shallow water on the Iowa shore - using an open-roofed timber cofferdam. They founded both of these piers on solid rock, using a 1-1/2-yard clamshell bucket mounted on a derrick to remove the overburden. Without an orange-peel bucket to scoop the large boulders and gravel that overlaid the bedrock, the men were often forced to hand-load the clamshell bucket. Very little excavation was needed for any of the cylinder piers for the eastern approach spans. The engineers discovered that the sand at the river's bottom would not support the weight of the steel tubes, however, and ordered piles to be driven under each to hold it in place until the concrete could be poured over the main piles in the cylinder centers. No excavation was necessary for Piers 3, 4 and 5: the large concrete supports located in the main channel of the river. For each of these, carpenters constructed a massive crib made of braced 8"x 8" pine timbers at the river's edge. The men then launched each crib and towed it into place over the pre-driven piles. WB&I resident engineer C.F. Womelsdorf described the cribbing process:

In sinking the cribs, boxes were built on top of the cofferdams at each end. These were loaded with crushed stone, which was afterwards used for concrete. This arrangement was used instead of the stone boxes on the sides. The joint between the crib and the cofferdam was made tight by calking with oakum. In each case, however, the material worked loose and the joint opened, so that it was necessary for a diver to go over the calking and stop the leaks when the pumping was started. All the pumping was done with an 8-in. centrifugal pump, which was of more than sufficient capacity.

Each crih was held in position by a cluster of four piles about 10 ft. above and below it, from which cables were fastened to the four corners. The piles were then driven inside the crih, before it was sunk. The cribs floated about 3 ft. above the surface of the water, and after being securely fastened they were used to lay off the spacing fort he piles. By this means the pile driving could be done very accurately; and although some of the piles were followed below the surface of the water and skewed off under the crosshracing, no great difficulty was experienced from this cause when the cribs were sunk. It was found that the crihs, when landed on the bottom, were practically in their correct positions. 56

The Greens' crew used a 20-ton Browning locomotive crane with a 50-foot boom to handle the cribs and cofferdams, place and remove the concrete forms, and position the pier plates and reinforcing steel. This was mounted on a track centered on a 24'x 86' scow. Another, larger scow was fitted with a 20-horsepower, double-drum Lidgerwood hoisting engine, a No. 12 Smith mixer and an 80-foot Insley tower for mixing and pumping concrete. The men maneuvered five other scows, ranging in size from 16'x 60' to 20'x 110', to shuttle materials from the shore to the big work barges. To drive the piles, the Greens' crew used a 3000-pound Vulcan steam hammer with a 3-foot stroke. Comprised of some 600 logs 35 to 40 feet long, these piles were driven to a penetration ranging from 15 to 30 feet below the surface of the river bottom - well into the blue shale hardpan beneath the sand. Each was calculated to sustain a load of 15 tons.57

All the subaqueous concrete in the tubular piers and on the main piers to within six feet of the low-water line was pumped into place through 10" galvanized iron tremies. These gravity-fed grout pipes were suspended from the boom of the hoisting tower by a line directly attached to the hoisting engine. The men later inserted a pair of double blocks in the support line to permit fine adjustments in the pipes' heights and angles.

The pier construction progressed without major incident throughout the summer. By mid-September all of the foundation piles had been driven and the westernmost two piers on the Iowa shore were complete. Virtually all of the superstructural steel had been delivered to the WB&I plant in Wisconsin from the Eastern mills for fabrication. The company began shipping truss components to Burlington by the railroad carload that month.

While the carpenters and concrete workers rushed to complete the piers on the Illinois shore in late October, the steelworkers began the erection of the superstructure over falsework on the Iowa side. By November 3rd they had installed the girder approach spans and the 140' deck truss and had begun driving the falsework piles east of the pier to support the anchor arms of the cantilever.58 Two weeks later all of the cylindrical piers had been completed, Pier 5 was almost ready for the steelwork and the forty-five-man crew was hurrying to build the formwork on Pier 4, despite the bitter cold.

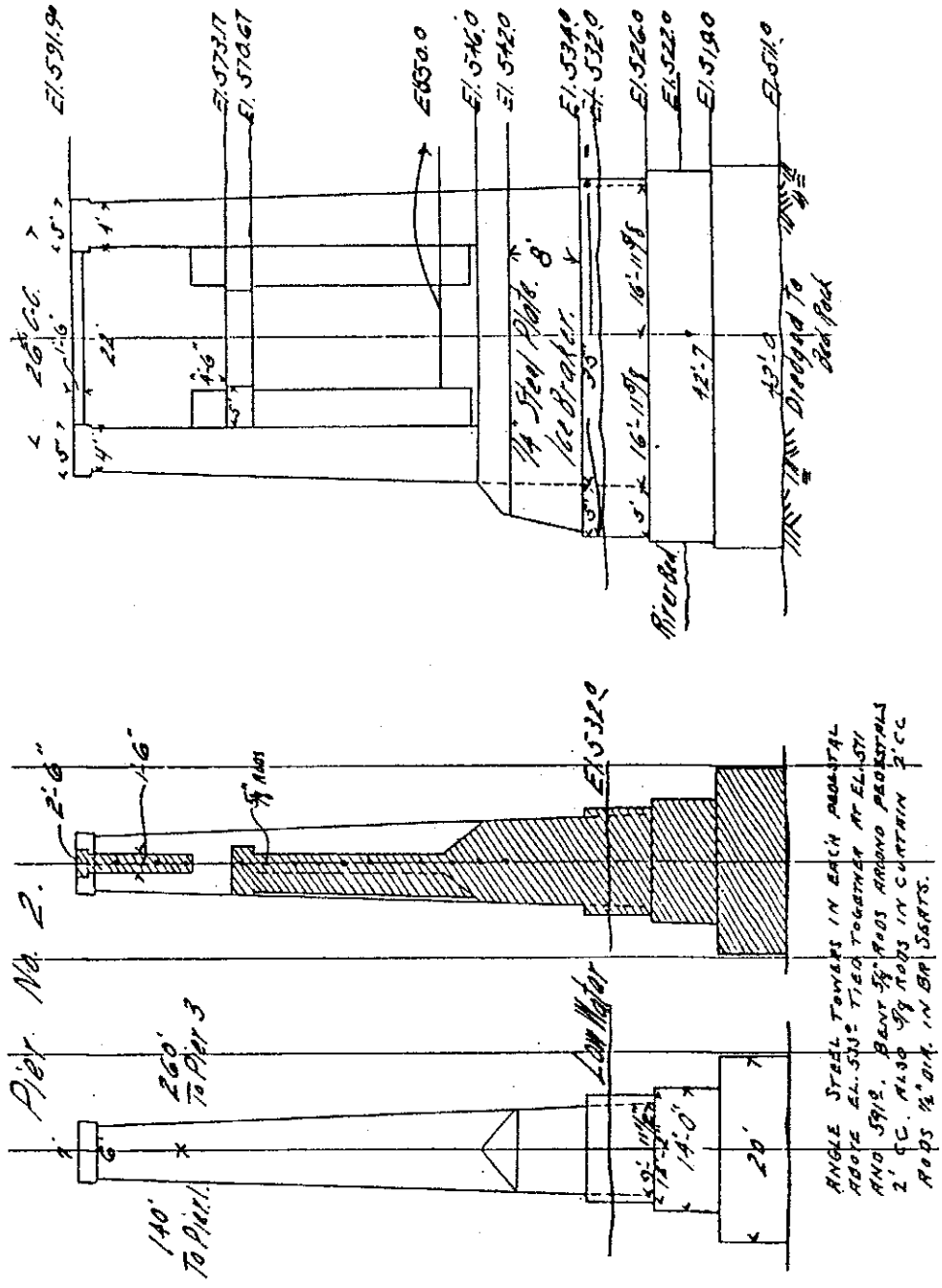


Figure 8 (taken from "Record of Piles Driven for Foundation of Piers and Abutments in the Burlington Bridge Built for the Citizens Bridge Co., Burlington Iowa, 1916," in possession of MacArthur Coffin, Burlington, Iowa.)

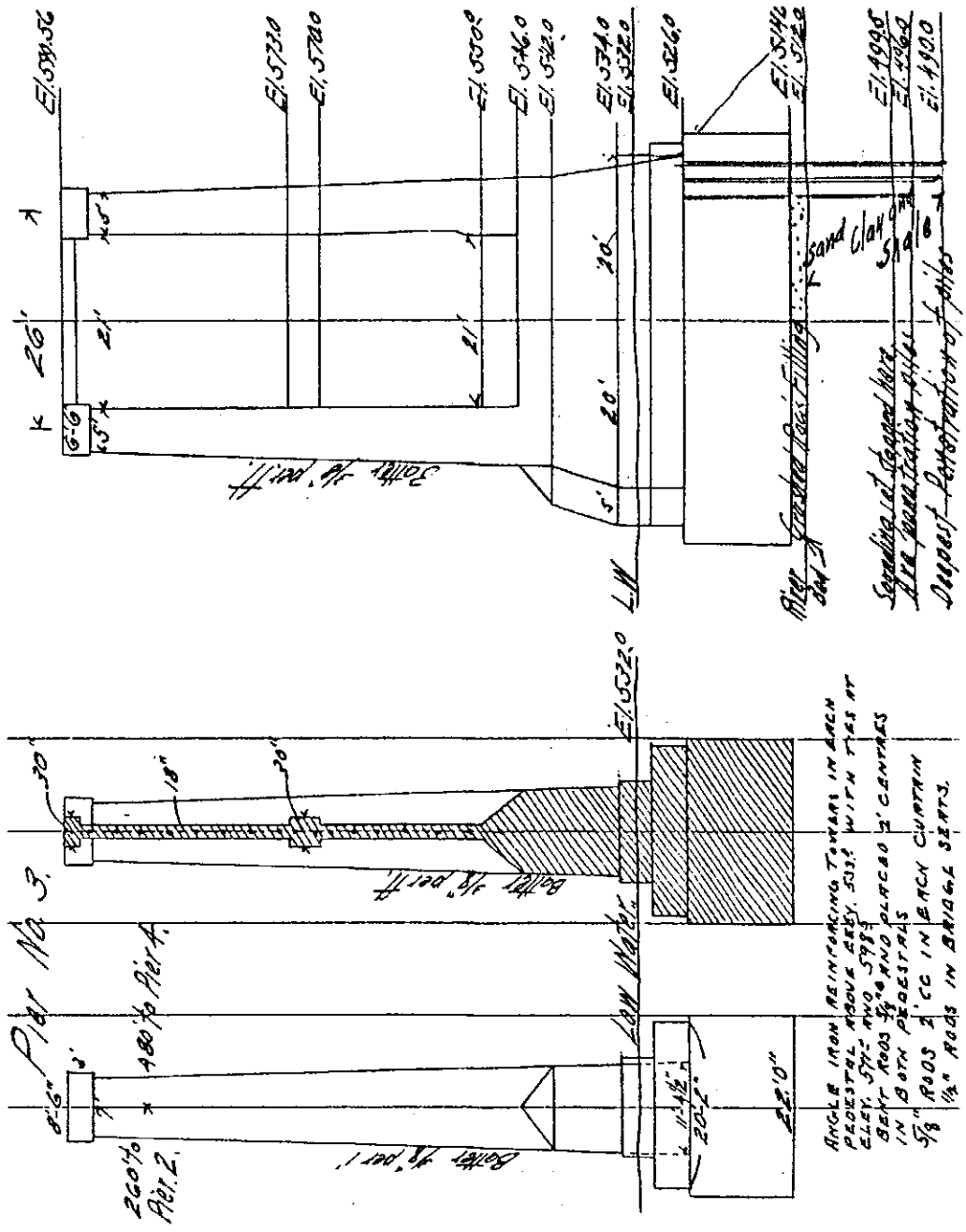


Figure 9 (taken from "Record of Piles Driven for Foundation of Piers and Abutments in the Burlington Bridge Built for the Citizens Bridge Co., Burlington Iowa, 1916," in possession of MacArthur Coffin, Burlington, Iowa.)

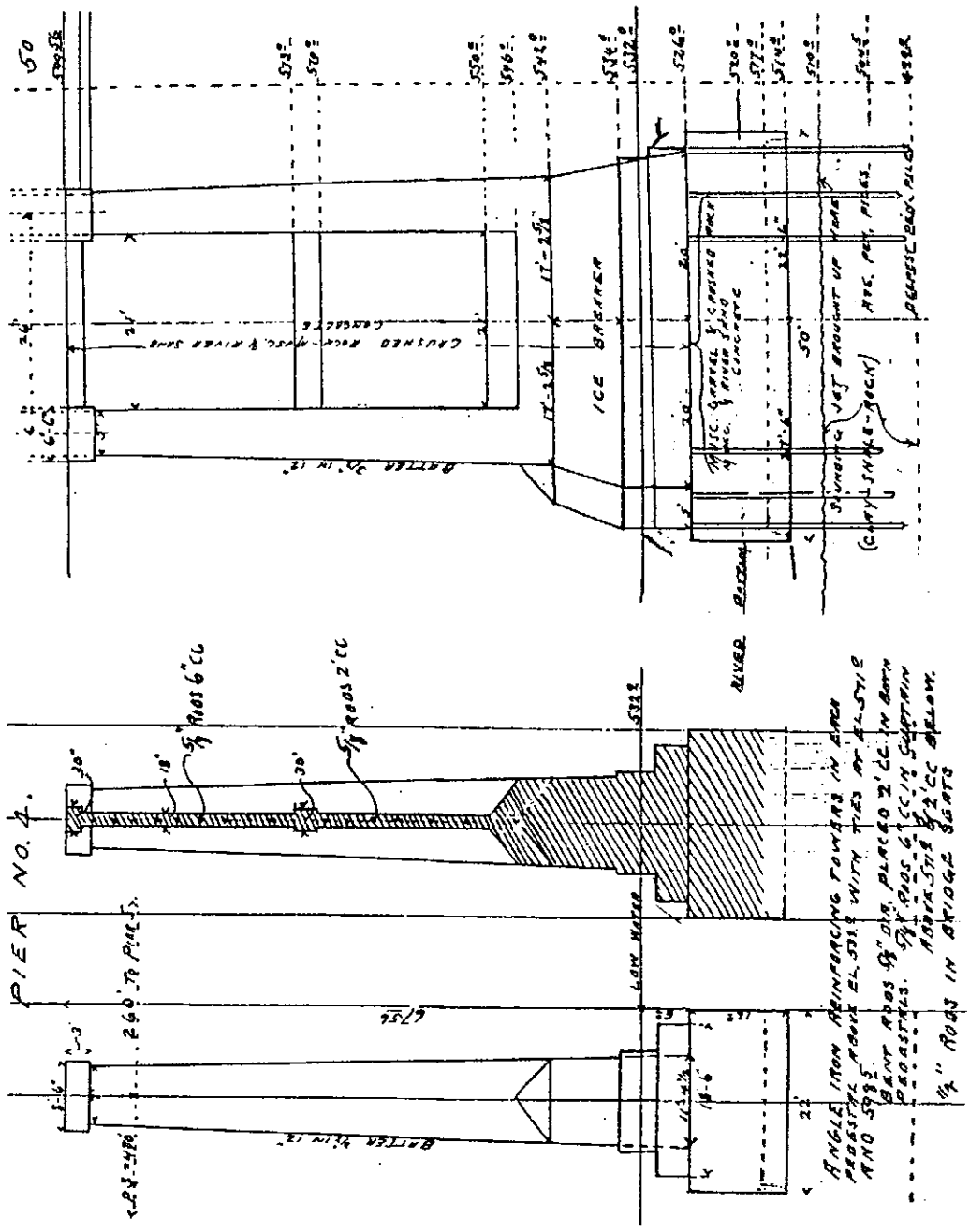


Figure 10 (taken from "Record of Piles Driven for Foundation of Piers and Abutments in the Burlington Bridge Built for the Citizens Bridge Co., Burlington Iowa, 1916," in possession of MacArthur Coffin, Burlington, Iowa.)

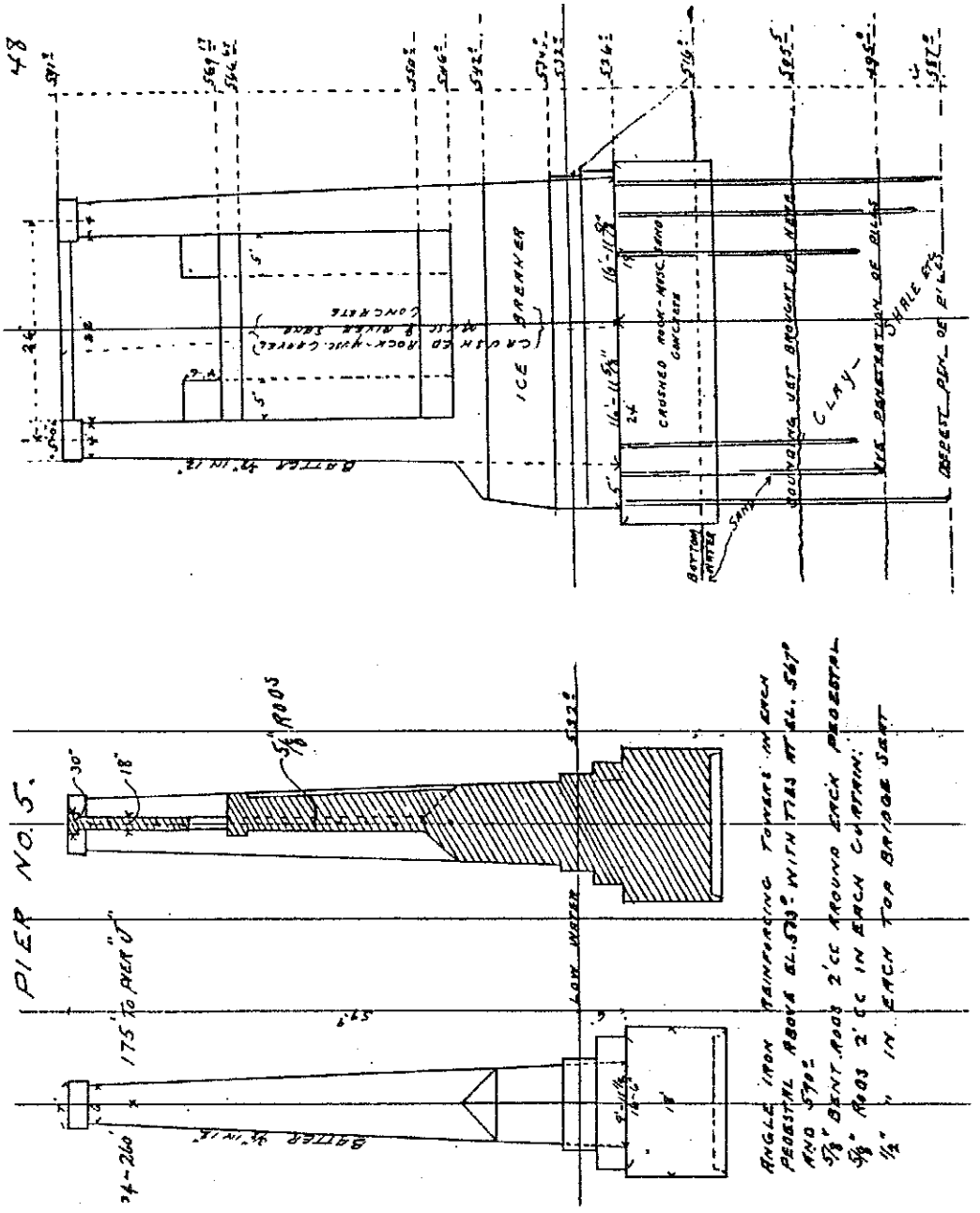


Figure 11 (taken from "Record of Piles Driven for Foundation of Piers and Abutments in the Burlington Bridge Built for the Citizens Bridge Co., Burlington Iowa, 1916," in possession of MacArthur Coffin, Burlington, Iowa.)

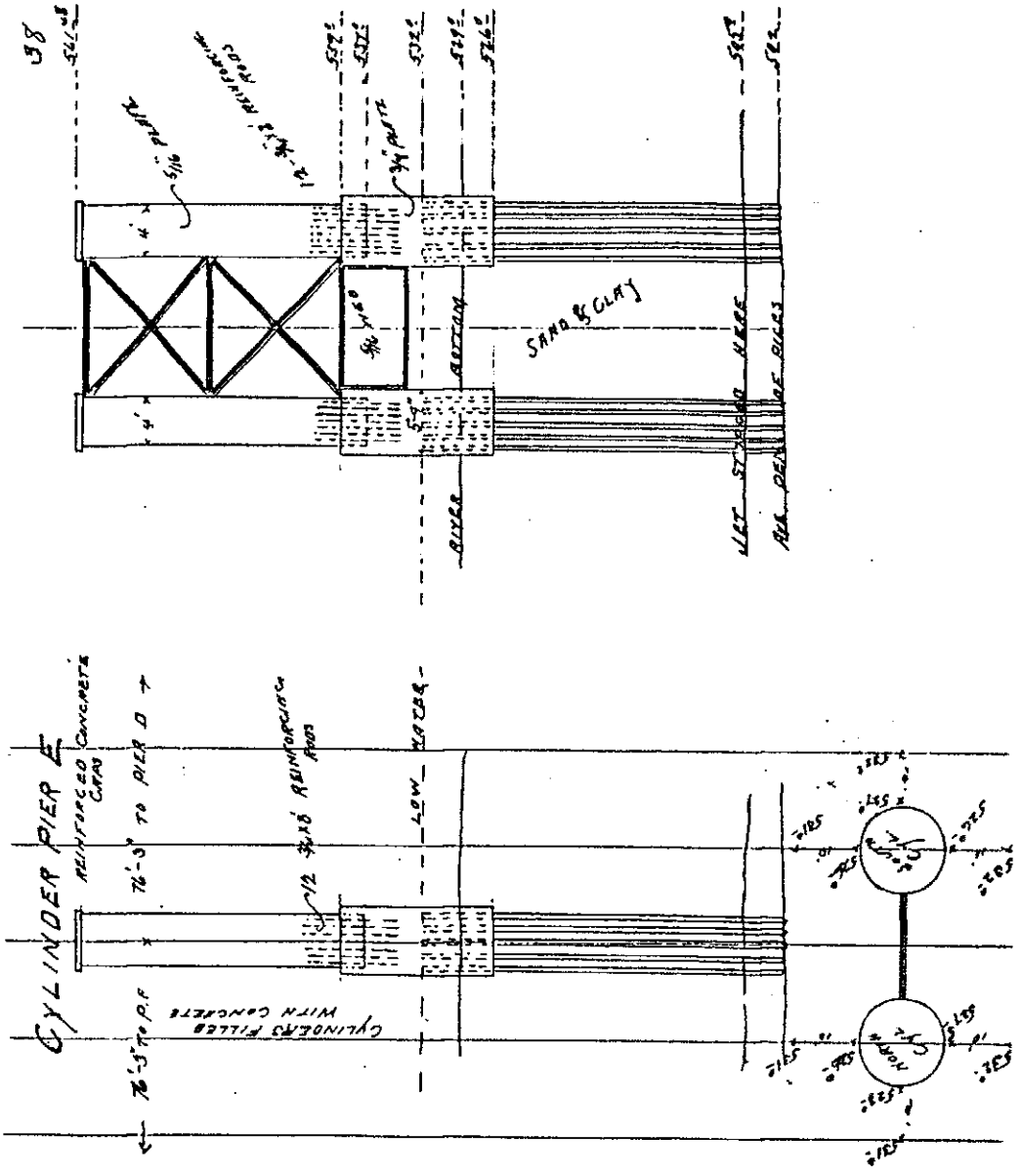


Figure 12 (taken from "Record of Piles Driven for Foundation of Piers and Abutments in the Burlington Bridge Built for the Citizens Bridge Co., Burlington Iowa, 1916," in possession of MacArthur Coffin, Burlington, Iowa.)

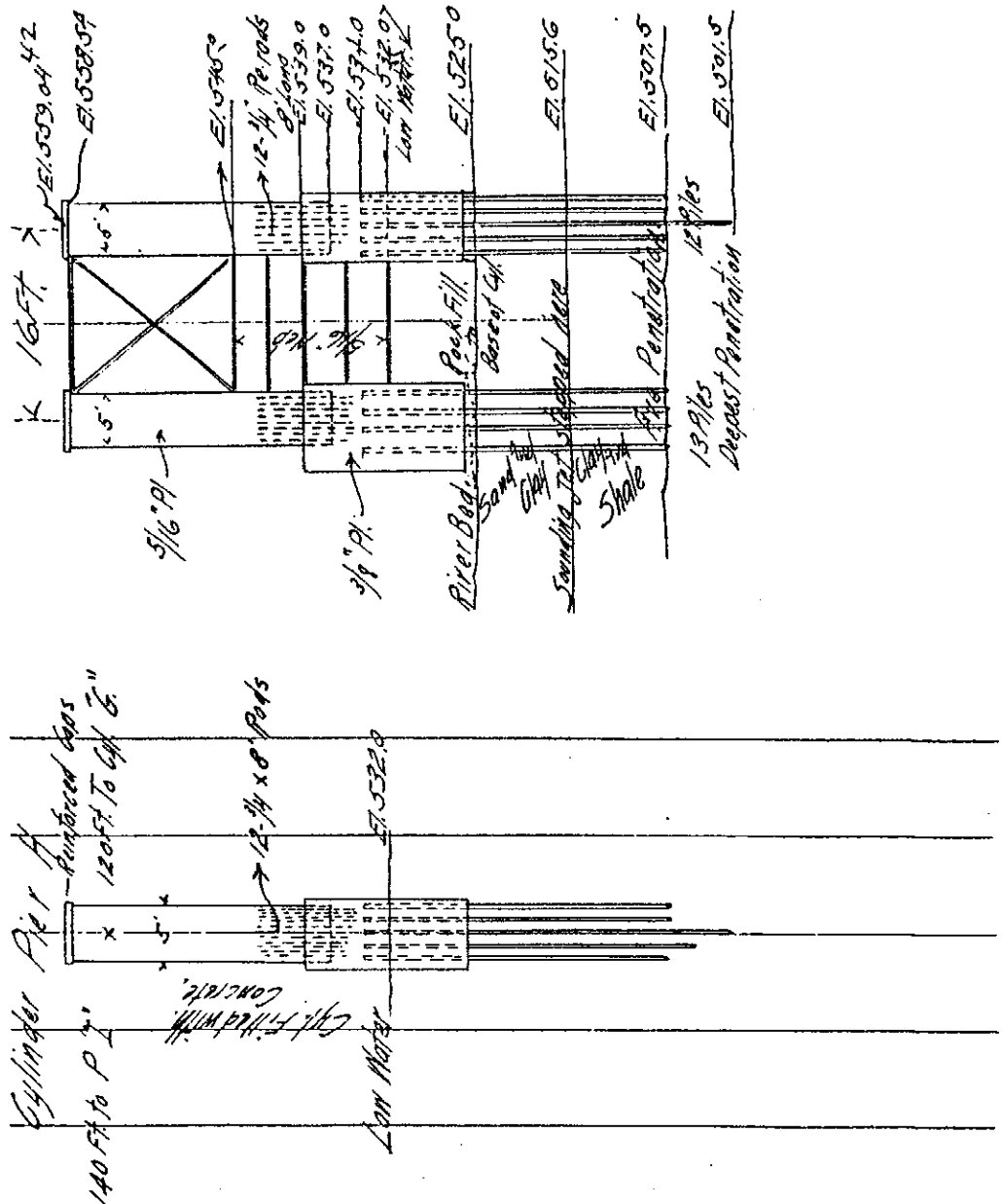


Figure 13 (taken from "Record of Piles Driven for Foundation of Piers and Abutments in the Burlington Bridge Built for the Citizens Bridge Co., Burlington Iowa, 1916," in possession of MacArthur Coffin, Burlington, Iowa.)

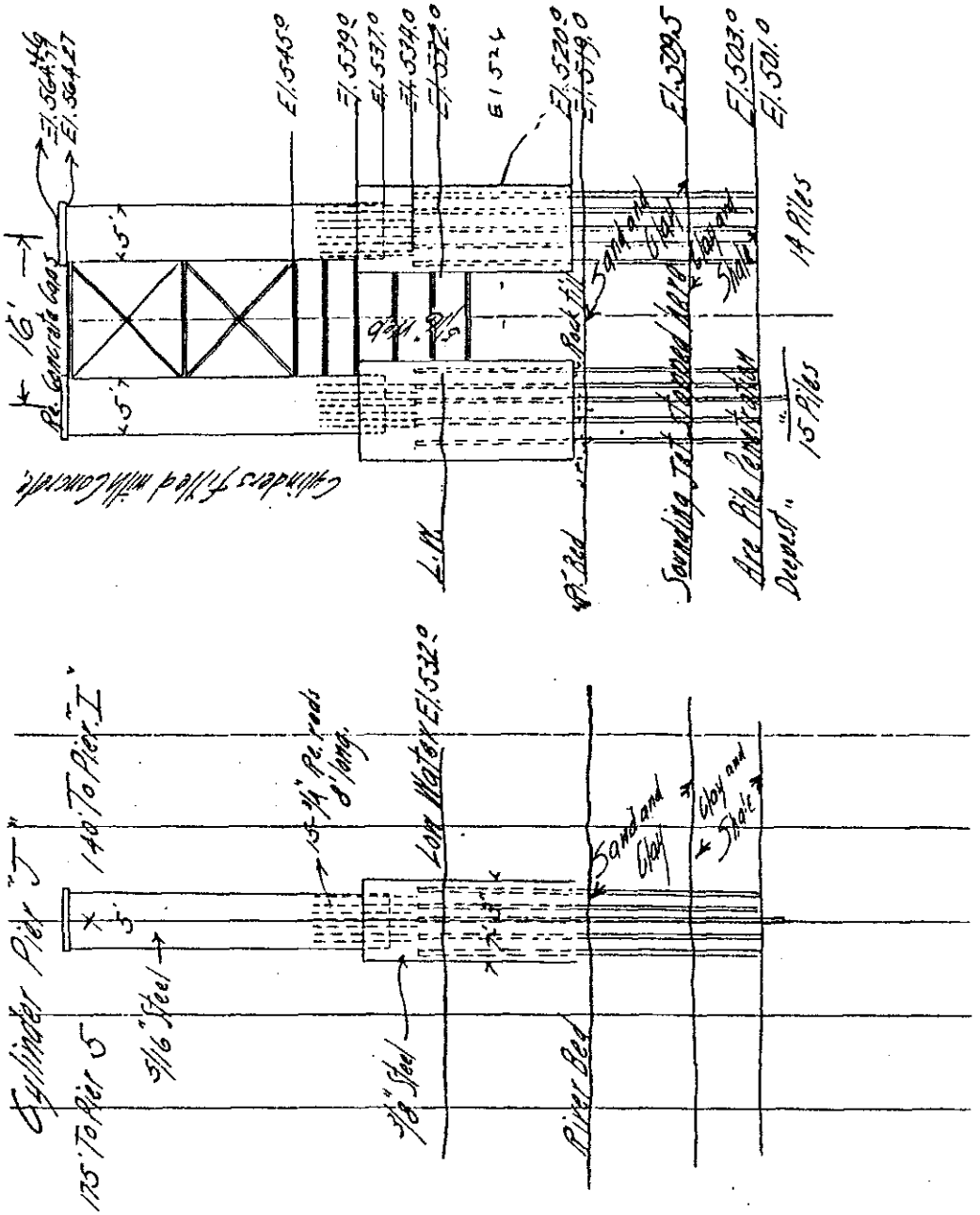


Figure 14 (taken from "Record of Pilee Driven for Foundation of Piers and Abutments In the Burlington Bridge Built for the Citizens Bridge Co., Burlington Iowa, 1916," in possession of MacArthur Coffin, Burlington, Iowa.)

Meanwhile, superstructural steel and creosoted lumber for the roadway deck were arriving on almost a daily basis from Wisconsin and were stored in the materials yard - or simply on the levee, when shipments came in too rapidly - at the base of Washington Street.[59] From there the men loaded the prefabricated components onto barges and hoisted them into place on the falseworks. When the river iced over, they built temporary ice bridges to haul the materials. The steelworkers on the bridge assembled the parts using a timber traveler powered by a steam-driven donkey engine. The *Hawk-Eye* reported the progress on November 29th:

> **Steel now extends two-thirds of the way to pier No. 3, reaching the second tower or set of false work, and by tomorrow operations will extend over a third set of false work and thence to the pier proper. The men on top of the bridge were hard at work yesterday and did the work rapidly, making every moment of the wonderful day count to make up for time lost during the biting cold weather of a short time ago. Huge steel girders were taken from the barge and hoisted into the air where steel workers "rode them" into place.** [60]

Green's crew completed the substructure on December 2nd. WB&I steelworkers on both shores of the river were pushing the work on the immense truss toward an early spring completion.[61] They assembled the 120' east approach span in four days early in the new year. The other deck trusses soon followed, until all that remained was to close the main span. As crowds of onlookers watched from the Iowa shore, the men extended the two cantilevered arms, panel by panel, late in January. For temporary support of the arms, they tied them to the towers over the piers using cables.[62] On February 10th the men hoisted the first connecting chord into place using derricks mounted on the cantilever arms. One daring steelworker hopped onto the beam as it was swinging into place and ran to the other side as the first person to cross the bridge.[63]

The remaining connections were riveted two days later. As the workers continued to install the roadway, the city began planning the grand opening celebration. "It is a foregone conclusion that a great jubilee gathering will be held in Burlington sometime this spring in honor of the completion of the highway bridge," the *Hawk-Eye* stated in March. "And should not this local success be made the occasion for general rejoicing. For more than forty years the people on both sides of the river have longed for a highway bridge. At last we have the structure. The earnest desires of a half a century are about to have fruition. We are justified in rejoicing." The paper continued:

> **The bridge was well financed, the construction work has been ably handled and the Bridge company will inaugurate public service under auspicious conditions. Such enterprises usually cost more than the original estimates, but this one has been so efficiently managed that the stock and bonds almost pay every expenditure.** [64]

The cost of the Citizens' Bridge, like the construction schedule, followed the original agreement closely, with only minor overruns. The original estimated cost had been $180,000. The total cost of the bridge was $210,176.89, over $200,000 of which was paid to Wisconsin Bridge and Iron, as follows:

F.O.B. cost of cantilever span	$39,378.58	
F.O.B. cost of deck truss spans	14,761.87	
F.O.B. cost of plate girder spans	10,196.34	
F.O.B. cost of I-beam spans	1,028.31	
F.O.B. cost of bents	5,747.79	
Total superstructure material cost		66,625.65
Erection of superstructure		37,486.68
Erection of wood floor		13,844.98
Erection of hand rail		5,747.79
Total superstructure cost		123,705.10
Adolf Green subcontract	47,500.00	
Sublet, general contract	4,750.00	
Foundation drilling and riveting (by W8&I)	191.77	
Overhead expense	67.69	
Straighten Pier J.	186.39	
Sublet, general contract	18.64	
Steel for tubular piers	3,888.97	
Reinforcing steel for concrete piers	2,412.35	
Foundation drawings	225.09	
Falsework drawings	19.36	
Total substructure cost		59,260.26
Miscellaneous		656.38
Total, as per original contract		183,621.74
Extras not included in original contract		18,093.12
Total paid to Wisconsin Bridge and Iron Company		$201,714.86 [65]

The bridge was opened to traffic at six o'clock in the morning of Thursday, March 29, 1917.[66] Toll collector Chris Reichert waved the Ford driven by Tom Nichols through as the first automobile across. Herman Holstein was the first paying pedestrian to cross the bridge. Although there was no formal dedication ceremony and really nothing to see on the Illinois shore, people crossed the structure all day long, either driving or walking, back and forth from Burlington. By day's end 92 cars, 15 single-horse wagons, nine tandem-horse wagons, three motorcycles and hundreds of pedestrians had crossed the bridge. MacArthur intended to maintain moderate tolls on the structure - only enough to provide for maintenance, create a predetermined profit for the investors and retire the debt. Each foot passenger paid 5 cents each way (children paid 3 cents); auto or truck driver with one passenger, 25 cents, plus 5 cents for each additional passenger; teamster driving a two-horse wagon, 25 cents; driver of a one-horse wagon, 20 cents; motorcycle rider, 15 cents; and bicycle rider, 5 cents.[67] The *Hawk-Eye* reported the following day:

> **The new highway bridge across the Mississippi river here was formally opened yesterday and there were scores who crossed from one shore to the other on a structure that Burlington dreamed of having some fifty years ago, but which did not become a reality until yesterday... President J.A. MacArthur of the Citizens' Bridge company, was gratified at the first day's showing and hopes and feels confident that the succeeding days will establish a big average. Everyone crossing had a good word to say for the bridge and what it means to Burlington can hardly be estimated.**[68]

The grand opening ceremony would never take place. As the bridge was nearing completion in the late winter months of 1917, tensions were increasing on both sides of the Atlantic Ocean, as America and Europe girded for World War I. Only a week after the Citizens' Bridge opened for business, the United States declared war against Germany. In light of this, a jubilee seemed grossly inappropriate.

OPERATING THE BRIDGE

Though never formally dedicated, the Citizens' Bridge performed far better than the other toll bridges that MacArthur had studied two years earlier and even better than he had optimistically predicted. Almost $20,000 were collected in the first year of operation, over $25,000 in 1918. Bridge revenues increased by at least 10% in each of the succeeding years.[69] According to the articles of incorporation for the Citizens' Bridge Company, ownership of the bridge would revert to the city when the outstanding bond indebtedness of the company had been retired. The company had a stipulated life of twenty years - until February 1935 - after which time its incorporation would expire. But the payoff came much sooner than anyone had predicted. Toll receipts were sufficient to retire the bonds in little over six years.[70]

True to his word, J.A. MacArthur informed the Burlington City Council on August 1, 1923, that the Citizens' Bridge Company was prepared to turn the immensely profitable bridge over to the city without obligation.[71] The total cost to the city had been only $95,000: the amount raised by the two-year tax levy. Council immediately voted to accept the structure. The councilmen also passed an ordinance officially changing the name of the structure to the MacArthur Bridge, to honor its promoter.[72] Called the "most profitable community property owned by any Iowa municipality" at the time by the *Hawk-Eye*, the MacArthur Bridge would prove to be immensely profitable. So profitable, in fact, that it acquired the nickname, "The Golden Goose," a mixed metaphor for the goose that laid the golden eggs. The city was now quick to praise MacArthur's far-sightedness. The *Hawk-Eye* stated:

> **Burlington did one of the wisest things in her recent history, when she listened to the sound advice given ber by J.A. MacArthur, and organized a bridge company. That was an old amusement here, and had heen done so often that at first there were many skeptics in the town. But having ascertained that the project was to be "put over" this time, there was genuine jubilation. Of course the doubters, the fellows who are against everything and who are forever pouring cold water upon everything were here and they were confident that the bridge would never be built. If it were built, then it would never pay.[73]**

The *Gazette* joined in, saying:

> **There is an old saying, and it's a true one, that "what's everybody's business is nobody's business." And this is perfectly true of the** efforts put forth for years by earnest and patriotic citizens of this town to get a wagon bridge over the river.

The people wanted the bridge; they realized its value, and everybody was agreed that it would be a good thing for the town. There was a superabundance of talk, but when it came to organizing the sentiment the leader was lacking.

A few years ago Mr. J.A. MacArthur, a well known business man who would be benefited no more or less than thousands of other citizens by the acquisition of a bridge, decided to see the bridge issue to a finish. He set about organizing a bridge company. Strange to relate, he did not let the project rest at that stage. He procured a charter from the government, but some delay was experienced on this score. Nothing daunted, he proceeded with his plans, consulted bridge engineers, got bridge figures and statistics from all points on the river and reported on his progress. He never was idle, and even before the charter was secured he had the bridge plans and had downed all opposition, so that he was ready to start work on the bridge when the charter arrived.

There is no use waiting until Mr. MacArthur dies to bestow upon him the credit for securing the bridge. To him belongs the honor, and the bridge is a fitting monument to his energy and public-spirited efforts. The bridge belongs solely and entirely to the citizens of Burlington and citizens of Burlington should not be otherwise but grateful to Mr. MacArthur for his untiring efforts in procuring for them this boon.

We wish to commend Mr. MacArthur's successful bridge campaign as one of the most conspicuous examples of unselfish public service that has ever been the lot of the Gazette to chronicle. This is saying something, as the Gazette has been patting people on the back hereabouts for the past eighty years. Citizens who do things are the real assets of any community. The MacArthur spirit will get this town anything it desires. 74

At first the city council allocated the bridge revenue to bridge maintenance and the retirement of municipal bonds. It took less than a year for the councilmen to begin diverting funds to other purposes, however, namely new furnishings for the city hall. The receipts came in at a steady pace, totaling over $4.5 million in thirty years. The city redirected some of the proceeds toward maintenance of the bridge, but by the early 1950s, the structure faced major renovation to rehabilitate it to H-20 standards.

Engineers for Wisconsin Bridge and Iron advised the city in 1951 to restrict the use of the bridge immediately to a 6,000-pound load limit until repairs to the floor could be made. According to WB&I, although the bridge had served well for 35 years, it was hopelessly outmoded to carry modern traffic and would need complete replacement. The company concluded ominously, "You are assuming grave responsibility by now allowing almost unrestricted traffic." Faced with the prospect of a new structure costing about $3.5 million, the city instead turned to Iowa City consulting engineer Ned L. Ashton in June 1951. After inspecting the structure and WB&I's stress sheets, Ashton laid at least some of the blame on the designing engineer:

The bridge was designed and built originally by the Wisconsin Bridge and Iron Co. of Milwaukee, Wis., in accordance with the conventional practices of that time for projects that were somewhat cramped for finances... There were no provisions [in the original stress calculations] **for such things as impact or portal action of heavy modern trucks. Even worse, some of the computed stresses were inconsistent in adjacent members, some of the sections that were provided in the main members were never connected, and the single plane portals and lateral bracing systems were ineffective to the extent that the whole bridge vibrated precariously and continuously under passage of every truck.** [75]

Additionally, Ashton found that the bridge's timber floor and steel stringers were badly deteriorated. He undertook the design for the extensive rehabilitation project later that year. Ashton's plan included replacement of the timber deck with a steel grate deck; strengthening of the deck support by replacing some stringers and splicing others; deepening of the floor beams by welding tee sections onto the top flanges; and repair and reinforcing of the web members and lateral bracing by welding new members into place. He also cantilevered a new grate-floored pedestrian sidewalk outside the south web. Undertaken in January 1952 by the Vogt and Conant Company, Structural Steel Erectors of Cleveland, Ohio, the large-scale rehabilitation was completed at a cost of about $800,000 in August.[76]

The structure has undergone several other repairs of varying scales since. In 1954 the Western Waterproofing Company of St. Louis reconditioned the surfaces of the concrete piers. These were again repaired in 1964 and 1965. In a 1967 inspection, Ashton noted serious cracking in the concrete of Piers 3, 4 and 5 - the main channel supports. These were reinforced by encasing the caps with heavy steel plates and bolting steel angles to form truss towers around the pedestals. In addition, the original grillage beams were replaced with new reinforced concrete grillages. In 1965 the Daly Construction Company built a new single tollhouse and west approach to replace the roadship houses at either end.[77] The superstructure was painted and repaired in 1973.[78]

The MacArthur Bridge continues to be a money-maker for the City of Burlington. The tolls have fluctuated to some extent over the 71 years since its opening, but they have historically been moderate, due in large part to the precedent setting first years under MacArthur's control. In fact, the toll for an automobile in 1988 is the same as the initial 1917 levy. Today the bridge can no longer carry the traffic load of U.S. Highway 34 over the Mississippi River, despite construction of new freeway entrance ramps from the west in the 1970s. With its toll structure on the west approach, narrow roadway and 34-ton load limit, the MacArthur Bridge forms a severe bottleneck for traffic entering or exiting Burlington from the east. It is now scheduled for replacement and demolition by the Iowa Department of Transportation.

ENDNOTES

1 William J. Petersen, *Steamboating on the Upper Mississippi* (1937: reprint edition, Iowa City, Iowa: State Historical Society of Iowa, 1968), pages 22-27; Henry Lewis, *The Valley of the Mississippi* (St. Paul: Minnesota Historical Society, 1967), pages 59-63.

2 George Conclin, *New River Guide, or a Gazetteer of all the Towns on the Western Waters* (Cincinnati, 1852), pages 67-71.

3 This bridge was replaced in 1877 by another, longer-span suspension bridge, which in turn was replaced by a series of steel arches. F.B. Maltby, "The Mississippi River Bridges: Historical and Descriptive Sketch of the Bridges over the Mississippi River," *Journal of the Western Society of Engineers*, August 1903, pages 419-20.

4 As quoted in F.B. Maltby, "The Mississippi River Bridges."

5 C.H. Hudson, "The Original Construction of the Burlington Bridge in 1867-68," *Journal of Associated Engineering Societies*, May 1894.

6 The single-track superstructure was replaced by double-track trusses in 1892-93. The original trusses were stored in the bridge material yard at West Burlington until 1895, when they were shipped to Cicero, Illinois and incorporated into the 52nd Avenue Overpass at the Morton Park station. The 1893 trusses remain in place, essentially unaltered. C.H. Hudson, "The Original Construction of the Burlington Bridge..."; George S. Morison, "Reconstruction of the Burlington Bridge," *Journal of the Association of Engineering Societies*, 1894, pages 599-614; "Farsighted Men Built Railroad Bridge," *Burlington Hawk-Eye*, 3 November 1963.

7 The original incorporators of the company included H.W. Chittenden, J.W. Gilbert, W.D. Gilbert, Philip M. Crapo, J.H. Sherfy, J.S. Schramm, E.H. Carpenter and R.M. Raab. Helen Turner McKim and Helen Parsons, ed., *Burlington on the Mississippi: 1833-1983* (Burlington: Doran & Ward Litho Company, 1983), page 32; "Movement to Span the Mississippi Was Strongly Established Here in 1887 But Failed to Materialize." *Burlington Gazette*, n.d., newspaper clipping located in scrapbook of MacArthur Coffin, Burlington, Iowa.

8 "Bridge to Illinois Result of Foresight, Work," *Burlington Hawk-Eye*, 21 July 1965.

9 "Issue MacArthur Bridge Report," *Burlington Gazette*, 29 August 1928; "Explains Bridge Plans," *Burlington Hawk-Eye*, 30 January 1915.

10 These incorporators were J.P. Sunderland, Thomas Hodge, John S. David, A.J. Burroughs, Moses Foote, among others. The articles of incorporation for the organization stated that its general nature of business would be to "facilitate, extend and protect the commercial and manufacturing interests of the city of Burlington." Augustine M. Antrobus, *History of Des Moines County, Iowa, and Its People*, Volume 1 (Chicago: S.J. Clarke Publishing Company, 1915), page 503.

11 The Commercial Club's stated purpose was "to promote the commercial interests of Burlington by the social intercourse of the members, a free exchange of views, and by organized efforts. Recognizing the fact that our railroads, manufactures, mercantile establishments, financial institutions, etc., are some of the chief factors that enter into the growth and prosperity of our town, with them we are in full accord, and to them therefore we may look for encouragement and assistance of a moral, and at all times of a substantial nature. As members of this club, we are but citizens of Burlington, and the public welfare in a commercial sense shall be our concern. By harmonizing if possible these various commercial interests, by united action and persistent effort we hope to secure the co-operation of our business men, and the approval of the public in general." *Portrait and Biographical Album of Des Moines County, Iowa* (Chicago: Acme Publishing Company, 1888), page 38.

12 Commercial Exchange Articles of Incorporation, as quoted in Augustine M. Antrobus, *History of Des Moines County, Iowa.*

13 "Long Illness Fatal to J.A. MacArthur, *Burlington Hawk-Eye*, 1 February 1939; "Frank Millard and Co.," *Burlington Hawk-Eye*, 1901; "Frank Millard, Pioneer, Dead," *Burlington Gazette*, 2 February 1909.

14 "Bridge to Illinois Result of Foresight, Work," *Burlington Hawk-Eye*, 21 July 1965; "Interesting History of the New Burlington Bridge," *Burlington Hawk-Eye*, n.d.

15 The members of the bridge committee were J.A. MacArthur, J. Lyman Edwards, George C. Boesch, Sam Gilbert and William Bongert. "Issue MacArthur Bridge Report," *Burlington Gazette*, 29 August 1928; "Bridge Is City's Most Important Port," *Burlington Hawk-Eye*, 3 October 1925.

16 Philip McPartland, "'The Goose' Has Been Laying Golden Eggs for Fifty Years," *Burlington Hawk-Eye*, 29 March 1967.

17 "Burlington Will Have Her Bridge Before Christmas," *Burlington Hawk-Eye*, 19 January 1915.

18 "The Bridge and the Auto," *Burlington Hawk-Eye*, 23 January 1915; "'The Goose' Has Been Laying Golden Eggs for Fifty Years," *Burlington Hawk-Eye*.

19 Articles of Incorporation of the Citizens Bridge Company:

Article 1) The name of this corporation shall be the Citizens Bridge Company.
Article 2) The principal place of business shall be at the City of Burlington, in the County of Des Moines, State of Iowa.
Article 3) The object of the corporation shall be to erect, own, maintain and operate or have a combination highway and interurban bridge across the Mississippi River from the city of Burlington to the opposite shore in Henderson County, State of Illinois, across said stream in accordance with the provisions of Section 759, Code of 1897. The Corporation shall have the right to buy, hold, sell and convey personal property and real estate as may be necessary for the proper conduct of the affairs of the Corporation in the construction of said bridge and the necessary appliances thereto, and may do and perform any other act that may be necessary in order to render said bridge useful for the purposes for which it is constructed. All conveyances of real property made by the Corporation shall be executed by the President and countersigned by the Secretary with an impression of the Corporate seal attached.
Article 4) The amount of the authorized capital stock of said Corporation shall be One Hundred and Fifty Thousand Dollars, divided into shares of One Hundred dollars each, but said corporation may commence business when Five Thousand dollars of said capital has been subscribed and paid for in cash. Of said stock One Thousand Two Hundred and Fifty Shares shall be designated as common stock. Voting power shall be vested only in the holders of common shares. No stock shall be issued until the Corporation shall have received payment in full therefor.
Article 5) The corporate period of this Corporation shall begin on the date the Secretary of State issues a certificate of incorporation and shall terminate twenty years from said date, unless sooner dissolved by a majority of the stockholders at any annual or special meeting called for that purpose, or by unanimous consent as provided by law.
Article 6) The affairs of this Corporation shall be managed by a board of not less than five (5) nor more than nine (9) directors, at least five of whom shall be of common stock. The Board of Directors shall fill

all vacancies occurring in its membership between the annual elections by the appointment of qualified persons to hold office for the remainder of the term.

Whenever the first semi-annual installment of taxes referred to in Article 10 shall have been paid in cash to this Corporation, then the City of Burlington shall appoint one Director to serve on the Board of said Corporation and thereafter as soon as each semi-annual installment of taxes is paid in cash to this Corporation, appoint one additional member until four Directors have been appointed, said Directors to hold office until the expiration of the corporate year or until their successors are appointed by the city and qualify.

The Board of Directors shall elect a President, Vice President, Secretary and Treasurer and such other officers, including an executive Committee, as they may see fit or as may be provided for by the by-laws of this Corporation. All of said officers, except the Secretary and Treasurer, must be stock-holders. All officers shall serve without compensation. Said Board of Directors shall have entire control and management of the property and affairs of the Corporation, and shall have the right to determine upon what terms said bridge shall be used by the public or by other Corporations, shall fix such tolls, rates and charges as may, in its judgment, be just and right, and in all other respects so manage and control the property of the Corporation as will best preserve and protect the same and render it useful to the community.

Article 7) The annual meeting shall be held on the first Monday in February of each year, at which time the Board of Directors shall be elected. Until the first annual meeting, which shall be held on Monday February 7, 1916, the following persons shall be Directors:

J.A. MacArthur, Burlington, Iowa.
George C. Boesch, Burlington, Iowa.
J.L. Edwards, Burlington, Iowa.
S.L. Gilbert, Burlington, Iowa.
Wm. M. Bongert, Burlington, Iowa.

and the following persons shall be officers:

J.A. MacArthur, president, post office address, Burlington, Iowa.
George C. Boesch, vice president, post office address, Burlington, Iowa.
Ed. E. Egan, secretary, post office address, Burlington, Iowa.
J.L. Edwards, treasurer, post office address, Burlington, Iowa.

All officers of this corporation shall hold office for the term of one year or until their successors have been elected and qualify. Special meetings of the stockholders may be called at any time by the president by giving five days' written notice of the business to be transacted at such meeting, directing such notice through the mails to the last known address of each stockholder, and such meeting shall be called at any time by the president upon the request of any ten stockholders, or may be called at any time by notice from any twenty stockholders addressed directly to the

stockholders of the corporation. At all meetings of the stockholders each common stockholder shall be entitled to one vote for each share of common stock held by him which vote may be cast in person or by written proxy.

Article 8) The highest amount of indebtedness to which this corporation may at any time subject itself shall not exceed two-thirds of the paid up and outstanding capital stock.

Article 9) The private property of stockholders shall be exempt from corporation liability.

Article 10) Should the City of Burlington under and by virtue of the provisions of the laws of Iowa, levy a tax for the purpose of aiding this Corporation in the construction of said bridge, this corporation is hereby pledged to give to the City of Burlington its shares of preferred stock equal in par value to the sum of money realized from the said tax levy and duly paid over to the corporation. Even shares of stock shall be given from time to time as the money is paid. In the event of the consummation of this arrangement and in the further event that this corporation shall issue and sell its bonds for the purpose of securing funds with which to complete the construction of its said bridge, then it shall be the duty of the officers and directors of the corporation to proceed as follows in the conduct of the affairs of the Corporation: From the net receipts from tolls and all other revenues and incomes from said bridge and from any other sources they shall pay first the agreed interest due upon its bonded indebtedness as it becomes due, then shall pay second a dividend of not to exceed six per centum per annum upon the par value of the common stock, then shall pay third all the remaining net receipts into a sinking fund which shall be available for no other purpose whatsoever except to buy for cancellation the said bonds of the Corporation and after all the said bonds have been purchased and cancelled then to buy the common stock. No holder of shares of common stock shall sell or transfer said shares until thirty days after having served upon the secretary of this Corporation written notice of such intention, the purpose of this provision being to give and shall give the corporation option to buy said offering upon its own account and the Corporation shall have the right then to buy said offering at not to exceed par and accrued dividend. In the event of such purchase of said shares by the Corporation, the same shall be re-issued by the directors. In the event the City of Burlington exercises its rigbts to buy the common stock it is hereby provided and declared that all holders of said common stock shall surrender their holdings of the same to the Board of Directors if and when said Board shall call fore such surrender giving twenty days notice thereof and offering in payment thereof par and whatever dividend, at the rate above provided, shall have accrued and be unpaid at the time specified for such surrender.

Should the City of Burlington have possessed itself of the preferred stock issued by this Corporation, as contemplated in the recitations at

the beginning of this paragraph, then it is hereby provided and declared that the said City shall have the right to purchase at par and accrued dividend all of the outstanding common stock of the corporation at such time as it may elect by giving thirty day's notice to the board of directors of its wish and purpose so to do, and at the same time pledging itself to assume and pay off any and every bonds and other legal and just liabilities and obligations of the corporation. Upon receipt of such payment and pledge from the City of Burlington by this Corporation, possession of said bridge and whatever other property it may own, shall be transferred forthwith to the City.

If it shall transpire that the City of Burlington does not exercise its option to buy the outstanding common stock of the corporation, and the sinking fund shall have provided sums sufficient to permit the purchase for cancellation of all the bonds of the corporation and to purchase at par and accrued interest all the outstanding common stock of the same, then and thereupon the said common stock shall be cancelled, the bridge and whatever other property the Corporation may have in its possession shall become the property of the City of Burlington and this Corporation shall proceed, without delay, to effect its legal dissolution.

Article 11) Amendments to these articles may be made at any annual meeting of the stockholders or at a special meeting called fore that purpose, two-thirds of all stockholders in interest voting for such amendments.

Dated this 6th day of February, 1915.
Signed:
Charles A. Schlichter
L.M. Eisfeld
E.G. Bandleon
Chas. Kriechbaum
Edward Rapp

20 "The Bridge and the Auto," *Burlington Hawk-Eye.*

21 "MacArthur Urges A Sinking Fund for Wagon Bridge," *Burlington Gazette,* n.d., clipping located in scrapbook of MacArthur Coffin, Burlington, Iowa; "The Essential Facts As to the New Bridge," *Burlington Hawk-Eye,* 9 February 1915; "Some Bridge Questions Asked and Answered," *Burlington Hawk-Eye,* 10 February 1915.

22 "Burlington's New Highway and Electric Railroad Bridge," *Burlington Hawk-Eye,* 27 January 1915.

23 "Charter for New Bridge," *Burlington Hawk-Eye,* 21 February 1915; "Building a New Bridge," *Burlington Hawk-Eye,* 3 March 1915.

24 "The Big Bridge Petition," *Burlington Hawk-Eye*, 18 February 1915.

25 "Bridge Petition Presented to the City Council," *Burlington Hawk-Eye*, 21 May 1915.

26 "Is Good for Burlington," *Burlington Hawk-Eye*, 9 January 1915.

27 "Burlington Women Guests of Commercial Exchange," *Burlington Hawk-Eye*, 8 July 1915.

28 "By a Vote of Five to One," *Burlington Hawk-Eye*, 1 July 1915; letter from Burlington City Clerk Robert Kroppach to J.A. MacArthur, 6 July 1915, located in scrapbook of MacArthur Coffin, Burlington, Iowa.

29 "Contract Was Let," *Burlington Gazette*, n.d., clipping located in scrapbook of MacArthur Coffin, Burlington Iowa; *Burlington Hawk-Eye*, 22 February 1917.

30 "'The Goose' Has Been Laying Golden Eggs for Fifty Years," *Burlington Hawk-Eye.*

31 Robert Newberry, "Wisconsin Metal Truss Highway Bridges," draft report for Wisconsin Department of Transportation, 1988; Victor C. Darnell, *American Bridge-Building Companies: 1840-1900* (Washington, D.C.: Society for Industrial Archeology, 1984), page 74.

32 John G. Gregory, *History of Milwaukee, Wisconsin*, Vol. IV (Chicago: S.J. Clarke Publishing Company, 1931); Milwaukee City Directory, 1887.

33 Wisconsin Bridge and Iron Company, Articles of Incorporation and Amendments; located at Corporation Division, Secretary of State, Madison Wisconsin.

34 *Polk's Wisconsin State Gazetteer and Business Directory, 1901-02* (Chicago, 1901), page 673.

35 Shirley du Fresne McArthur, *North Point Historic Districts - Milwaukee* (Milwaukee, Wisconsin: North Point Historical Society), page 95.

36 Wisconsin Bridge and Iron continued to expand after construction of the MacArthur Bridge in 1917. Building other Mississippi and Missouri River bridges in the 1920s, the company was reportedly worth $1 million in 1936. WB&I ceased operations in 1983. Robert Newberry, "Wisconsin Metal Truss Highway Bridges."

37 Kenneth Bjork, *Saga in Steel and Concrete: Norwegian Engineers in America* (Northfield, Minnesota: Norwegian-American Historical Association, 1947), pages 157-58; "The Famous Bridge at Hastings," *Gopher Historian*, Spring 1969, pages 25-27; F.B. Maltby, "The Mississippi River Bridges: Historical and Descriptive Sketch of the Bridges over the Mississippi River,"

38 P.B. Wolfe, ed. *Wolfe's History of Clinton County, Iowa* (Indianapolis: Bowen and Company, 1911); *Railway Age Gazette*, January 1910, pages 85-9.

39 J.B. Johnson, C.W. Bryan and F.E. Turneaure, *The Theory and Practice of Modern Framed Structures* (New York: John Wiley and Sons, 1900), page 197.

40 J.A.L. Waddell, *Bridge Engineering* (New York: John Wiley & Sons, Inc., 1916), page 25; David Plowden, *Bridges: The Spans of North America* (New York: W.W. Norton and Company, 1974), pages 123-24, 138-40, 165-66; Carl W. Condit, *American Building* (Chicago: University of Chicago Press, 1968), pages 145-47; "The Principal Bridges of the World - A Comparison," *The Engineer*, 24 May 1918, page 441.

41 The cantilevers that exceeded more than 400' were:

CANTILEVER BRIDGES

Serial Number.	Span. ft.	Span. in.	Crossing.	Location.	Railroad Tracks.	Highway.	Deck or Through	Date of Completion.
1	1800	0	St. Lawrence River	Near Quebec, Canada	2	*	Through	190..
2	1182	0	East River	Blackwell's Id., New York		*	"	190..
3	812	0	Monongahela River	Pittsburgh, Pa.	2		"	1904
4	790	5	Mississippi River	Memphis, Tenn.	1	*	"	1892
5	700	0	Ohio River	Mingo Junction, O.	2		"	1904
6	671	0	Mississippi River	Thebes, Ill.	2		"	1905
7	660	0	Colorado River	Red Rock, Cal.	1		"	1890
8	650	0	Ohio River	Marietta, O.		*	"	1903
9	555	9	Ottawa River	Ottawa, Ont.	1	*	"	1900
10	525	0	Long Lake	Hamilton Co., N. Y.		*	"	1901
11	523	0	Hudson River	Poughkeepsie, N. Y.	2		Deck	1888
12	520	0	Kentucky River	Tyrone, Ky.	1		"	1889
13	520	0	Ohio River	Cincinnati and Newport		*	Through	1891
14	483	0	Ohio River	Louisville, Ky.	1	*	"	1886
15	480	0	Kanawha River	Point Pleasant, W. Va.	1		"	1888
16	477	0	St. John River	St. John, N. B.	1		"	1885
17	470	0	Niagara River	Niagara Falls, N. Y.	2		Deck	1883
18	450	0	Allegheny River	Highland Park, Pittsburgh		*	Through	1900
19	442	0	Mississippi River	Muscatine, Ia.		*	"	1889
20	420	0	Mississippi River	Clinton, Ia.		*	"	1892
21	420	0	St. Lawrence River	Cornwall, Ont.	1		"	1899
22	413	0	Allegheny River	Bet. Reno and Oil City, Pa.		*	"	1902

Mansfield Merriman and Henry S. Jacoby, *A Text-book on Roofs and Bridges: Part IV, Higher Structures* (New York: John Wiley & Sons, 1907), page 89.

42 J.A.L. Waddell, *De Pontibus: A Pocketbook for Bridge Engineers* (New York: John Wiley and Sons, 1898), pages 56-57.

43 J.A.L. Waddell, *Economics of Bridgework* (New York: John Wiley & Sons, 1921), page 83.

44 Quoted in F.B. Maltby, "The Mississippi River Bridges: Historical and Descriptive Sketch of the Bridges over the Mississippi River," pages 457-58. The Dubuque High Bridge has since been replaced.

45 F.B. Maltby, "The Mississippi River Bridges: Historical and Descriptive Sketch of the Bridges over the Mississippi River," pages 463-64, 470-71. Both the Muscatine the Clinton bridges have since been replaced.

46 "The Winona Bridge," *Engineering Record*, 25 August 1894, pages 200-201. The Winona Bridge has been replaced.

47 Bridges below Minneapolis that carried vehicular traffic over the Mississippi River in 1916 were (listed from north to south):

Location	Date	traffic	truss type	contractor
Hastings MN	1895	highway	simple	Wisconsin Bridge & Iron
Red Wing MN	1895	highway	simple	Toledo Bridge Company
Winona MN	1894	highway	cantilever	Chicago Bridge & Iron Co.
La Crosse WS	1890	highway	swing	Clinton Bridge & Iron Co.
Dubuque IA (Eagle Pt.)	1901	highway	simple	unknown
Dubuque IA	1887	highway	cantilever	Horace E. Horton
Clinton IA (Lyons)	1891	highway	simple	Chicago Bridge & Iron Co.
Clinton IA	1891	highway	cantilever	Clinton Bridge & Iron Co.
Rock Island IL	1895	rr/hwy	swing	Phoenix Bridge Company
Muscatine IA	1891	highway	cantilever	Milwaukee Bridge & Iron
Fort Madison IA	1887	rr/hwy	swing	Union Bridge Company
Keokuk IA	1916	rr/hwy	swing	Strobel Steel Const. Co.
Hannibal MO	1886	rr/hwy	swing	unknown
St. Louis MO (McKinley)	1910	rr/hwy	simple	unknown
St. Louis MO (Free)	1912	rr/hwy	simple	unknown
St. Louis MO (Eads)	1874	rr/hwy	arch	Keystone Bridge Company

F.B. Maltby, "The Mississippi River Bridges: Historical and Descriptive Sketch of the Bridges over the Mississippi River"; U.S. Army Corps of Engineers, Upper Mississippi Valley Division, St. Louis, *The Middle and Upper Mississippi River - Ohio River to Minneapolis* (Washington, D.C.: Government Printing Office, 1940); David Plowden, *Bridges: The Spans of North America.*

48 "Contract Was Let," *Burlington Gazette.*

49 "Cantilever Highway Bridge over the Mississippi," *Engineering News*, 22 March 1917, pages 466-68.

50 "More Than Two Million Dollars in Improvements," *Burlington Hawk-Eye*, 10 December 1916; "Cantilever Highway Bridge over the Mississippi," *Engineering News.*

51 "Cantilever Highway Bridge over the Mississippi," *Engineering News.*

52 "Burlington Gets Christmas Gift," *Burlington Hawk-Eye*, 16 December 1915; "The Birth of the Burlington Bridge," *Burlington Hawk-Eye*, 19 December 1915.

53 *Burlington Hawk-Eye*, 22 February 1917.

54 "New Burlington Bridge To Be Finished by January 1, 1917," *Burlington Hawk-Eye*, 15 September 1916.

55 "Bridge Preparedness," *Burlington Gazette*, 26 April 1916.

56 C.F. Womelsdorf, "Building Bridge Piers in the Mississippi River," *Engineering News*, 8 March 1917, pages 382-84.

57 C.F. Womelsdorf, "Building Bridge Piers in the Mississippi River."

58 "Bridge Steel Work Has Reached Second Pier," *Burlington Hawk-Eye*, 3 November 1916.

59 "Extend the Steel Work," *Burlington Hawk-Eye*, 16 November 1916.

60 "Making Good Progress," *Burlington Hawk-Eye*, 29 November 1916.

61 "Steel Work Will Now Go Forward without Hindrance," *Burlington Hawk-Eye*, 5 December 1916.

62 "Cantilever Highway Bridge over the Mississippi," *Engineering News.*

63 "One Beam Joins Steel," *Burlington Hawk-Eye*, 11 February 1917.

64 "A Bridge Celebration," *Burlington Hawk-Eye*, 3 March 1917.

65 Summary of Actual Costs, prepared for Citizens' Bridge Company by Wisconsin Bridge and Iron Company, 4 October 1917; located in scrapbook of MacArthur Coffin, Burlington, Iowa.

66 "Bridge Traffic is Heavy," *Burlington Hawk-Eye*, 30 March 1917; Philip D. Jordan, *Catfish Bend, River Town and County Seat: An Informal History of Burlington, Iowa, 1836-1900* (Burlington: Craftsman Press, 1975), page 326.

67 "Bridge Ready for Business," *Burlington Gazette*, n.d., clipping located in scrapbook of MacArthur Coffin, Burlington Iowa; "Bridge Traffic is Heavy," *Burlington Hawk-Eye*.

68 "Bridge Traffic is Heavy," *Burlington Hawk-Eye*.

69 Receipts and disbursements were:

	Receipts	Disbursements
1915-16		
Preferred stock (taxes)	95,694.21	
Common stock	25,000.00	
Bonds	80,000.00	
Materials sold	220.00	
Interest from bank	1,564.76	
Bridge construction		210,176.89
Interest on bonds		36,100.00
Common stock dividends		11,510.87
1917	19,910.75	4,831.42
1918	25,340.05	7,095.52
1919	31,749.74	12,854.29
1920	37,886.41	11,686.99
1921	40,356.82	12,997.18
1922	43,054.27	22,687.60
1923 (to August 1)	26,825.40	6,742.86

"Movement to Span Mississippi Was Strongly Established Here in 1887 But Failed to Materialize," *Burlington Gazette*, n.d., clipping located in scrapbook of MacArthur Coffin, Burlington, Iowa.

70 "Issue MacArthur Bridge Report," *Burlington Gazette*, 29 August 1929.

71 The Citizens' Bridge Company outlasted its sponsoring organization, the Commercial Exchange. The exchange had by then given way to a new group, the Greater Burlington Association [GBA]. Some members of the GBA were reluctant to see such a profitable venture turned over without charge to the city. A GBA committee petitioned the Iowa legislature for an election and special bond to administer the bridge when the city took it over. A bill was introduced, but it died in committee. Philip McPartland, "'The Goose' Has Been Laying Golden Eggs for Fifty Years," *Burlington Hawk-Eye*, 29 March 1967.

72 "City Pays High Tribute to Man Who Built the Bridge," *Burlington Hawk-Eye*, 1 August 1923.

73 "Burlington's Best Bet," *Burlington Hawk-Eye*, n.d.; newspaper clipping located in scrapbook of MacArthur Coffin, Burlington Iowa.

74 "The Man Who Did the Work," *Burlington Gazette*, n.d., clipping located in scrapbook of MacArthur Coffin, Burlington Iowa.

75 Ned L. Ashton, "The Reconstruction of the MacArthur Bridge," *The Welding Journal*, April 1954, pages 313-23.

76 Ned L. Ashton, "The Reconstruction of the MacArthur Bridge."

77 Philip McPartland, ""The Goose' Has Been Laying Golden Eggs for Fifty Years," *Burlington Hawk-Eye*, 29 March 1967.

78 Iowa Department of Transportation, "Environmental Assessment and Preliminary Case Report, U.S. 34/Burlington Bridge over the Mississippi River between Des Moines County, Iowa, and Henderson County, Illinois," 15 July 1985.